TECHNOLOGY DEPT.

UGUST, 1956

ontents, page 695

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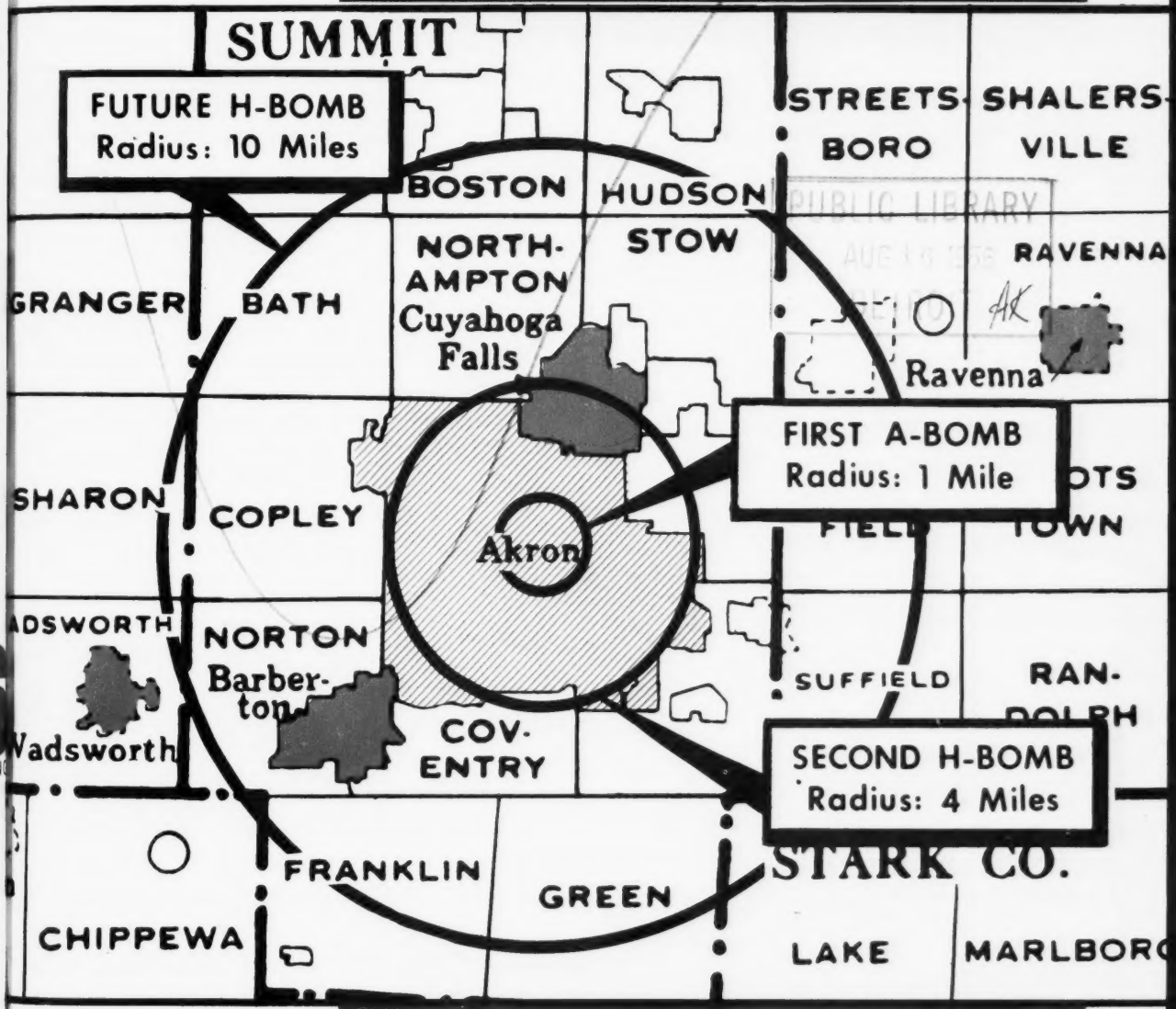

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UBLICATION

THE RUBBER INDUSTRY *IS* VULNERABLE TO ATOMIC ATTACK

By Neil P. Hurley, S. J., page 697

PEPTIZATION

A good peptizer does more in the breakdown of crude rubber or GR-S than merely soften or plasticize. "Peptization" implies a chemical action within the mass that assists greatly in rendering the rubber free of troublesome nerve and toughness. Mechanical breakdown alone requires much more time and power to reach the same degree of plasticity.

A well-peptized rubber shrinks less and is more easily processible in later manufacturing operations.

RPA NO. 6

is a good peptizer for natural rubber and all types of GR-S. Its use saves breakdown time and power. It does not accelerate or retard curing. Scrap is not mushy when reworked. Calendered and extruded stocks shrink much less—maintain more uniform gauges and generally process better.

RPA No. 6 is non-dermatitic**... has no offensive odor

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a "proof" of trup

The bright yellow linemen's suits pictured at right must provide warm, comfortable protection plus full freedom of action. They also must be strong and long-wearing and retain their light color for safety through high visibility.

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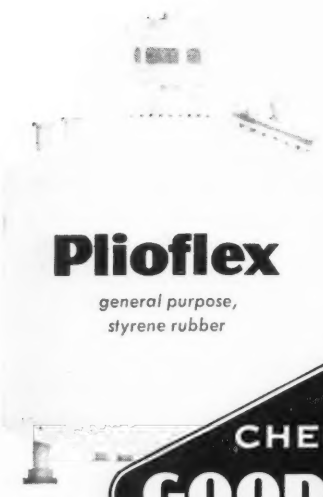
PLIOFLEX 1006 is a nonstaining, non-discoloring styrene rubber. It's readily mixed and calendered onto the fabric. And it's easily vulcanized into a lightweight, waterproof, abrasion-resistant coating that remains soft and flexible, even at low temperatures, and does not discolor upon weathering or aging.

Since changing to PLIOFLEX 1006, the manufacturer of the suits shown reports not one complaint from the field on color or durability. Moreover, he is well pleased with his savings in material and production costs.



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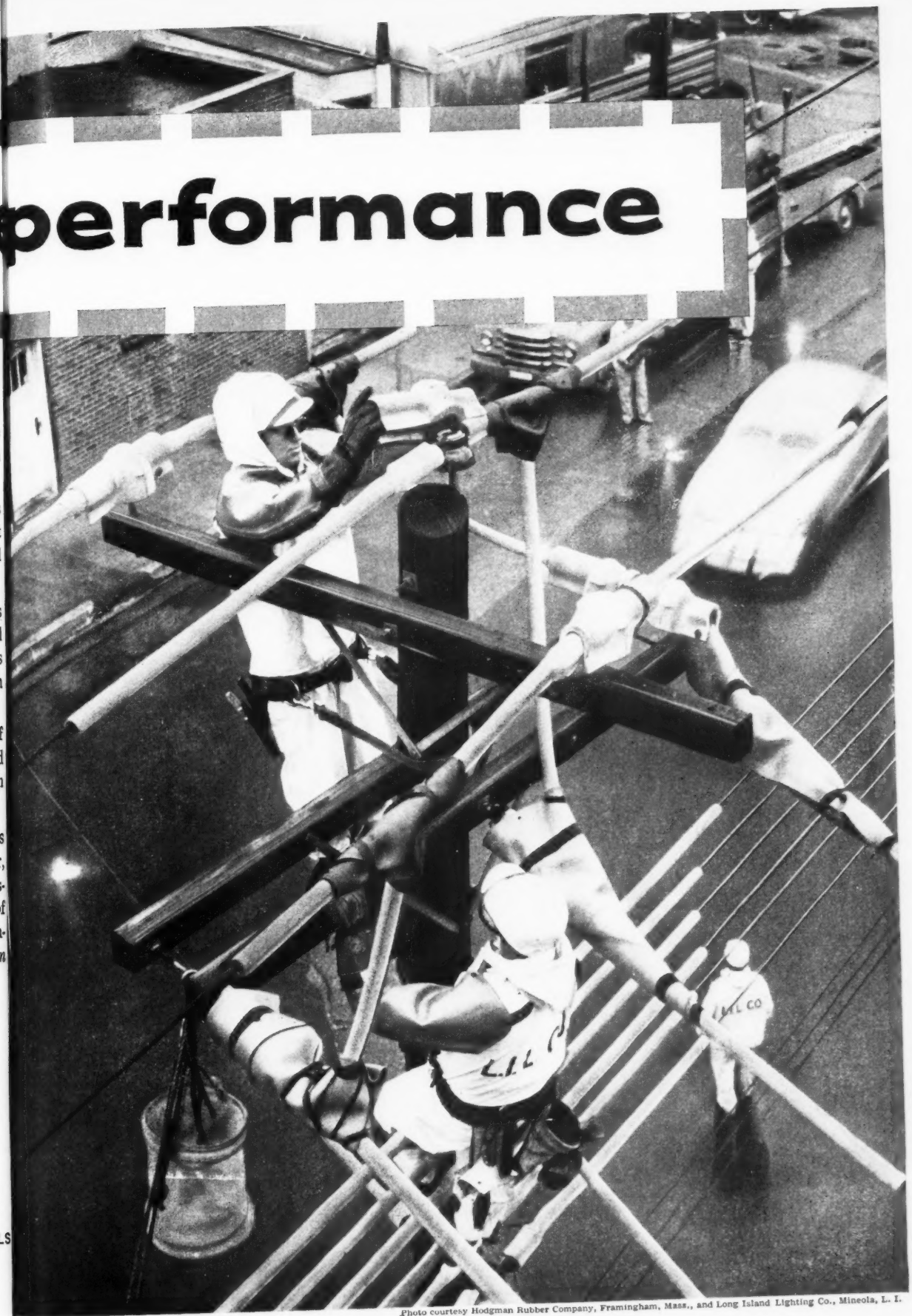
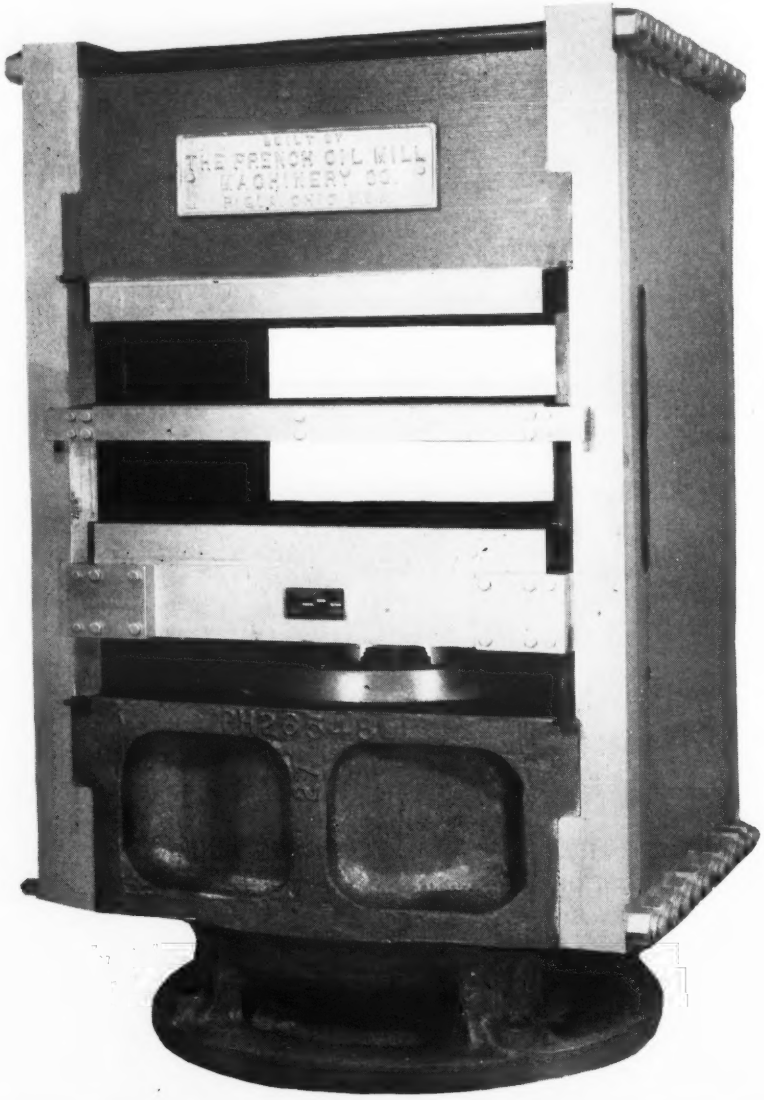


Photo courtesy Hodgman Rubber Company, Framingham, Mass., and Long Island Lighting Co., Mineola, L. I.



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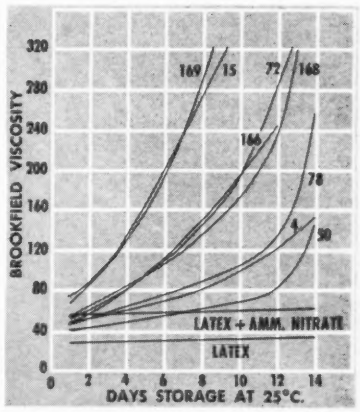
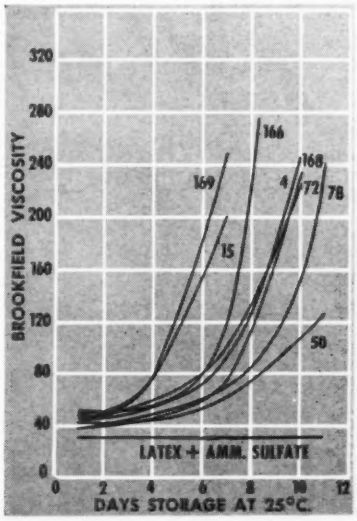
So . . . for best results, test the widest range of types—the Horse Head family—including the exclusive Kadox and Protox* brands.



Influence of zinc oxides on the chemical stability of latex containing 1% NH_4NO_3



Influence of zinc oxides on the chemical stability of latex containing 1% $(NH_4)_2SO_4$.

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XX-78	3.9		✓	
XX-4	4.4	✓		
Protox–166	4.4	✓		✓
Kadox–72	7.9		✓	
Protox–168	7.9		✓	✓
Kadox–15	10.0		✓	
Protox–169	10.0		✓	✓

*U. S. Patents 2,303,329 and 2,303,330

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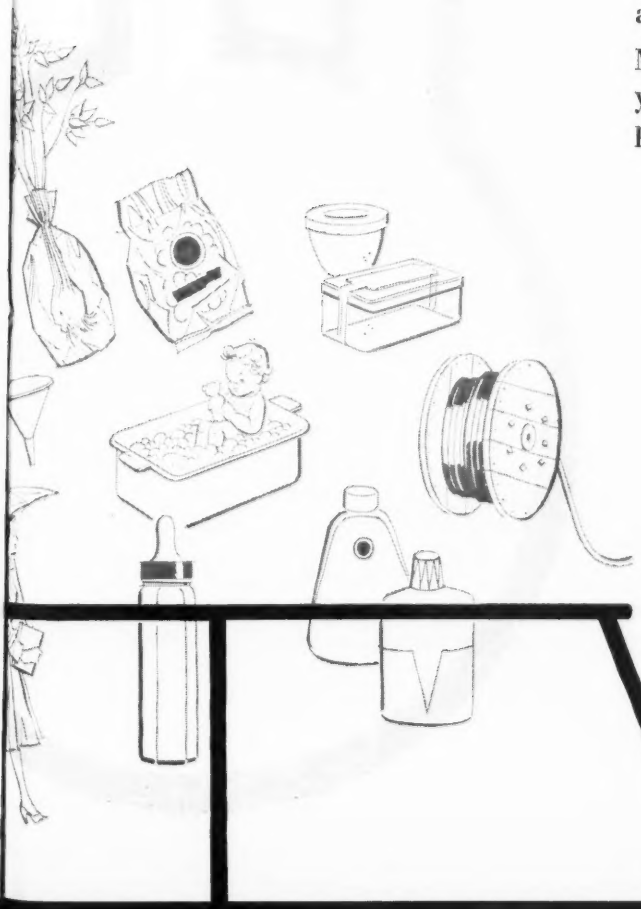

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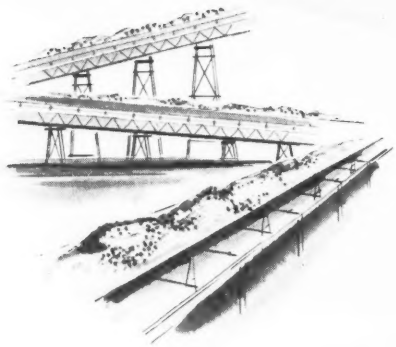

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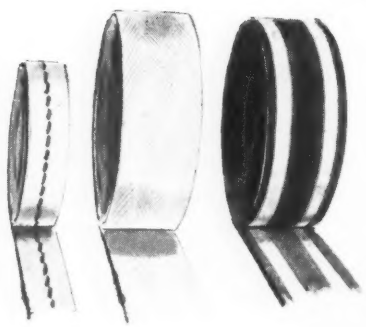
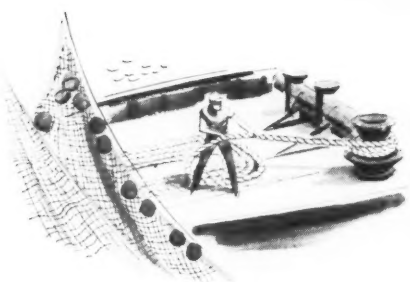


Webbing



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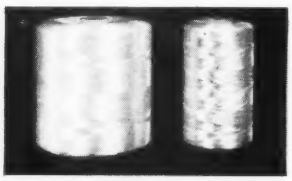

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	DOP	DIOP	DDP
Density 20/4	0.983	0.983	0.963
EMC* at 1,600 psi	50.3	51.4	53.7

**Equivalent Modulus Concentration (phr)*

INDOIL plastics evaluation laboratory checks quality of INDOIL Alcohols by testing finished product. Here operator measures elongation of plasticized vinyl strip to determine Equivalent Modulus Concentration of plasticizer.

No need to reformulate—Compounders plasticizing with DOP need not refigure formulations in order to use DIOP or DDP. They can be modified by using this table:

	Ratio $\frac{\text{Plasticizer phr}}{\text{DOP phr}}$	
	100% Elong. at 1,600 psi	100% Elong. at 900 psi
DOP	1.000	1.000
DIOP	1.022	1.019
DDP	1.068	1.086

Contact your supplier—Ask your plasticizer manufacturer for samples of DIOP, DDP and other esters made with INDOIL Oxo Alcohols. INDOIL Chemical Company does not manufacture esters.

Information—Send for INDOIL Bulletins Nos. 22 and 23.

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In *your* products, use the preferred rubber . . . Ameripol.

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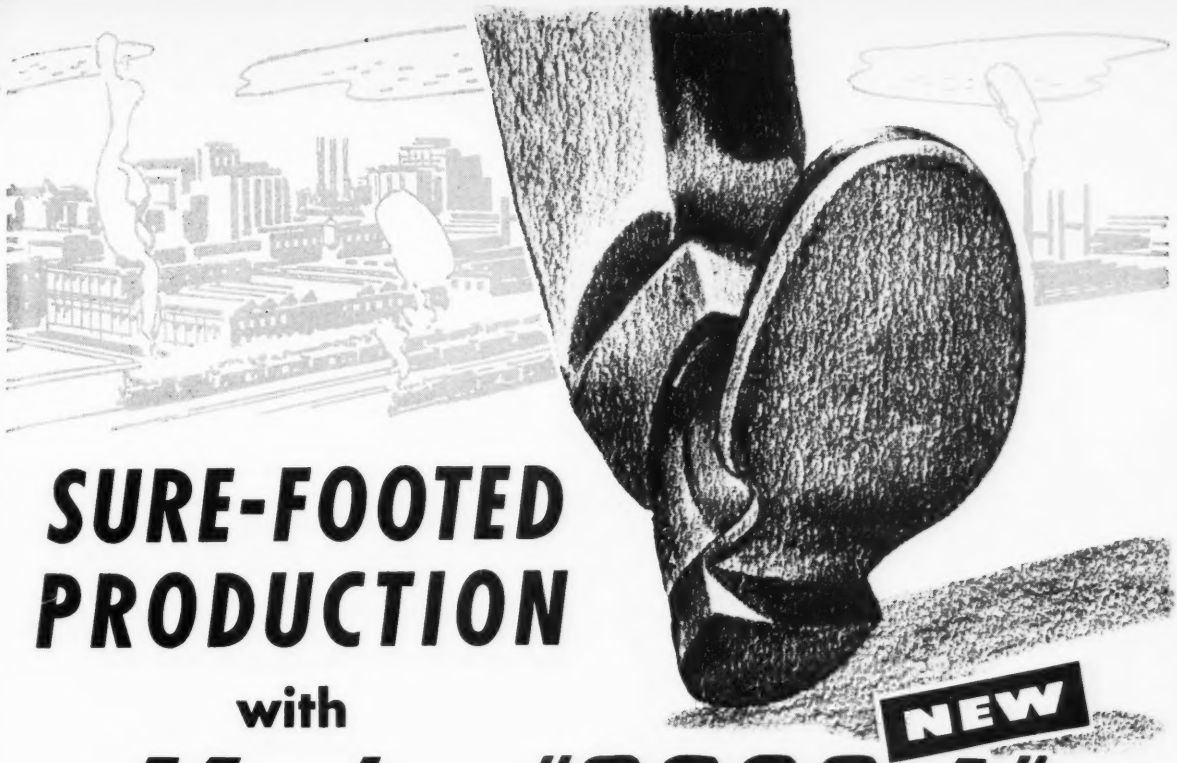

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impart desired properties to rubber stocks

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One of these pigments usually will give you the physical property you are seeking, but in some cases, a combination of the pigments is required. In any event, if you have a rubber reinforcing problem, it will pay you to investigate Hi-Sil, Calcene and Silene now.

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- Make white or light colored rubber goods possible while providing excellent vulcanizate reinforcement.
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- Improve abrasion resistance.
- Dry sticky or gummy reclaim stocks to a workable consistency.

Columbia-Southern pigments are solving rubber compounding problems every day . . . making rubber products perform better and look better, frequently at no added cost.

For property tables, experimental working samples, or recommendations, contact Pigments Department today at our Pittsburgh address.

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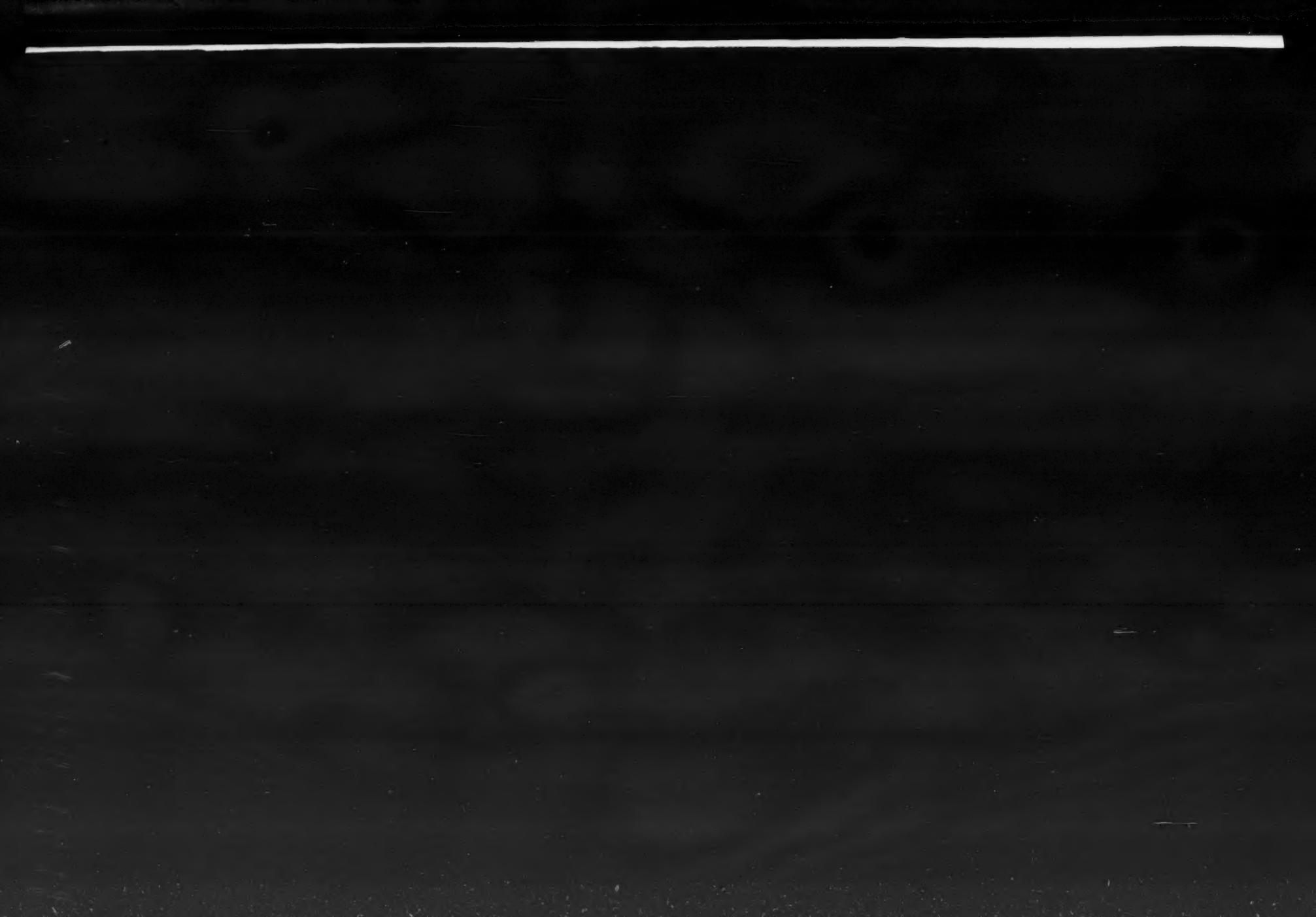
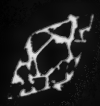


FINEST QUALITY



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United Blacks . . . they are the quality blacks so dependable and so helpful in today's rubbers. UNITED BLACKS are used everywhere, for every rubber need.

KOSMOS 70 ISAF — Ideal for toughest treads, maximum mileage tires, for gruelling high speed highway operations, and for high electrical conductivity.

KOSMOS 60 HAF — Recommended for good processing, highest reinforcement, extra mileage tires, tread rubber (camelback), and outstanding resistance to cuts and cracks.

KOSMOS 50 FEF — Superior as processing aid; for imparting good, smooth, fast extrusions; for maintaining dimensional stability; for dissipating heat.

KOSMOS 40 HMF — Recommended for good processing, substantial reinforcement, ready dispersion, high rebound, low heat build-up, high resistance to flex.

KOSMOS 35 GPF — For tire body stocks and general purpose applications where high resiliency, low heat build-up, high strength at elevated temperature and good flex resistance are essential.

KOSMOS 20 SRF — Excellent for highly loaded rubber goods; easy and cool mixing; semi-reinforcing; low in heat generation; high in resilience.

KOSMOBILE 77 EPC — Recommended for good processing, for high level of reinforcement, high tensile strength, good resistance to abrasion.

KOSMOBILE S-66 MPC — For rubber goods requiring high reinforcement, high tensile strength, highest resistance to tear and good resistance to abrasion.

KOSMOS BB (Voltex) CC — Ideal in polyethylene for resistance to ultraviolet radiation; for coloring of plastics and for high electrical conductivity.

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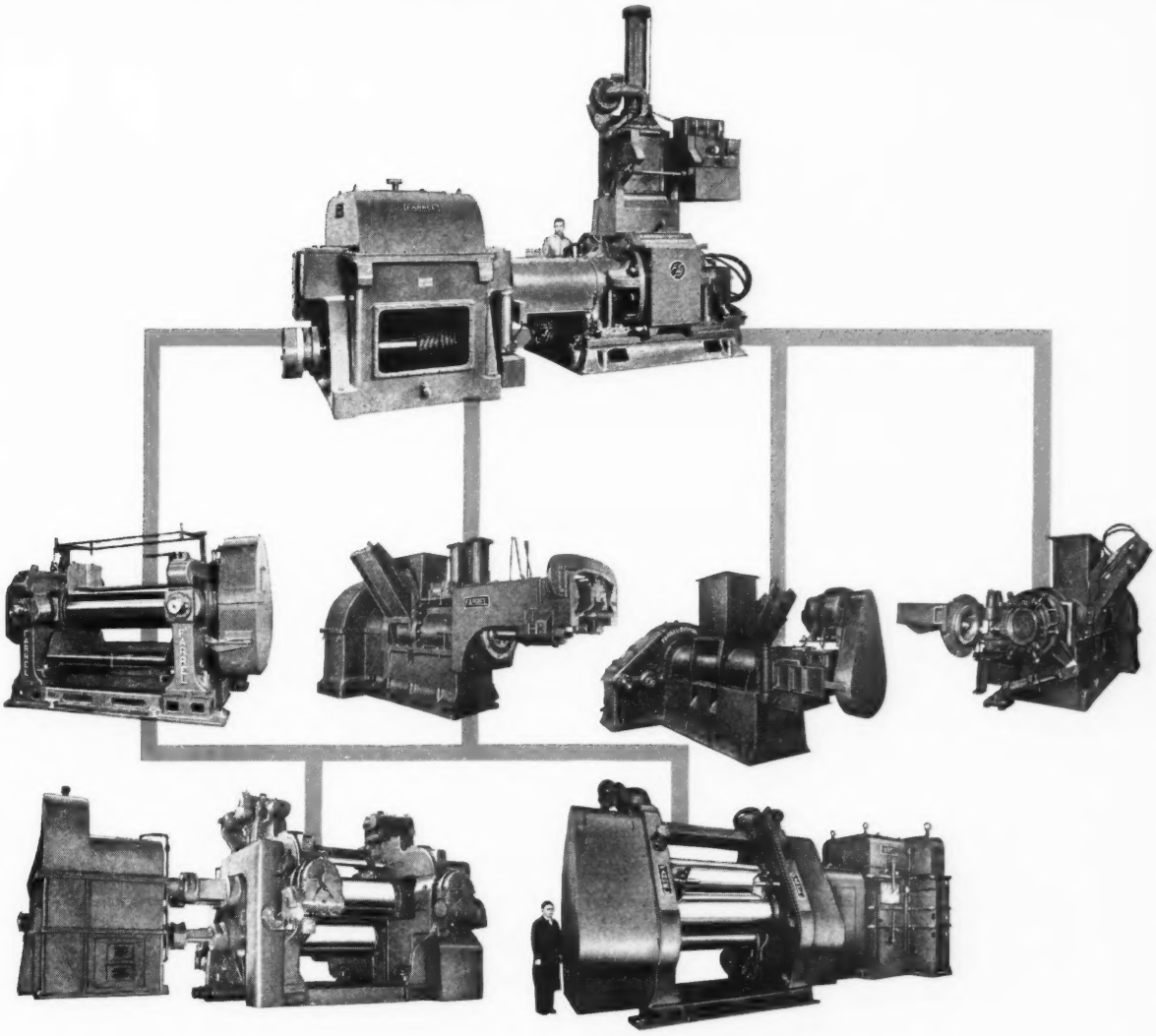
Matched production units: key to processing efficiency



Farrel-Birmingham® units for processing rubber and plastics—such as Banbury® mixers, mills, calenders and extruders—are built in a wide range of sizes with many optional features. When specific requirements are known, we can recommend machines of correct capacity and design to operate in sequence most efficiently. All necessary auxiliary equipment of proper design and capacity can also be engineered into your layout and can be furnished by Farrel-Birmingham to make your installation complete, with engineering responsibility centered at one source.

In such a layout, production flows evenly without costly interruptions caused by the starving or choking of succeeding machines. Furthermore, manual aid and supervision are reduced to a minimum. In some cases an individual machine will require no operator at all.

Before you purchase new processing equipment, why not look into the advantages of F-B® matched production units? Just tell us what your requirements are, and we shall be glad to quote you on matched units which will improve production efficiency and cut handling costs through planned processing flow.

FB-1090

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Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Fayetteville (N. C.), Los Angeles, Houston.

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Banbury Mixers • Plasticators • Pelletizers • Extruders • Calenders • Mixing, Grinding, Warming and Sheeting Mills • Refiners • Crackers • Washers • Hose Machines • Bale Cutters • Hydraulic Presses • Injection Molding Machines • and Other Equipment for Processing Rubber and Plastic Materials.

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ST. JOE lead-free **ZINC OXIDES** are available in a complete series of grades for rubber compounds. Quality control from ore to oxide is one of St. Joe's most important production tools. This, together with prompt deliveries, unequalled and unbiased customer service, accounts for their rapidly increasing use in the industry.

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FINE PARTICLE SIZE *Surface Treated*	**Black Label #20-21**
MEDIUM PARTICLE SIZE *Surface Treated*	**Green Label #42-21**
SPECIAL GRADES FOR LATEX	**Black Label #20** **Green Label #12, #46**
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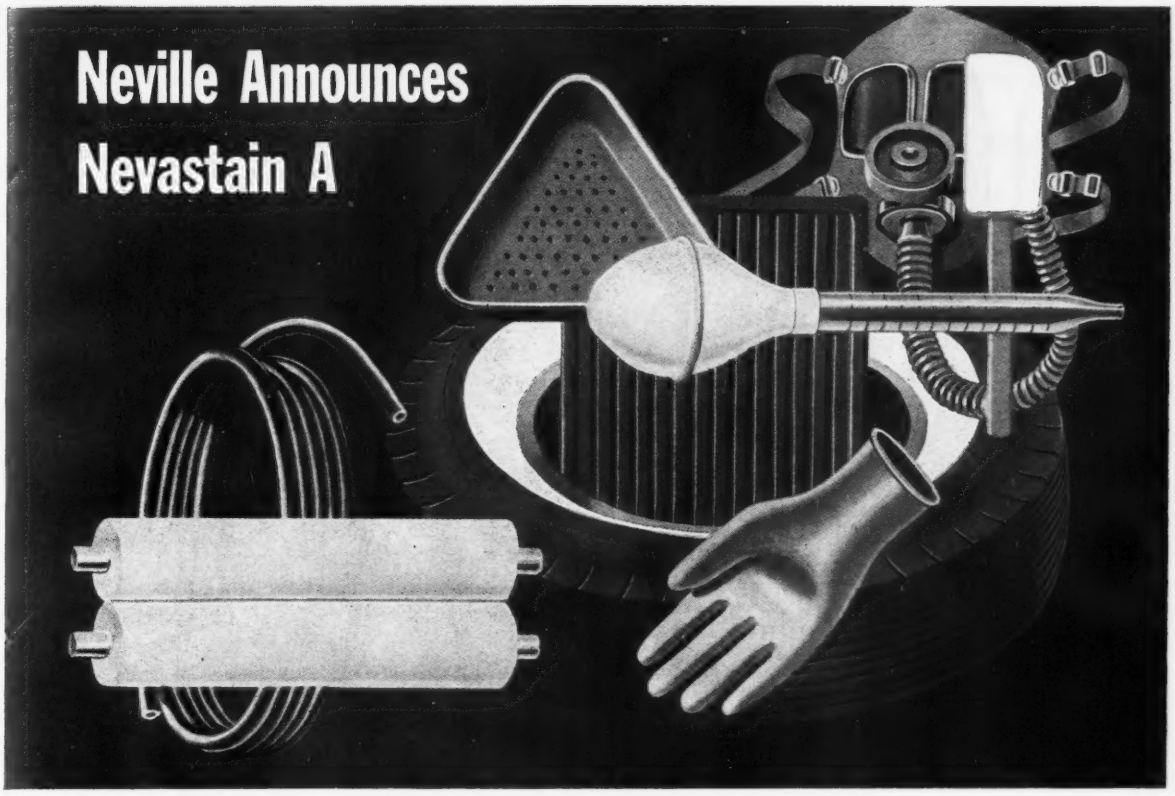
Complete data on all grades, and samples for testing sent on request.

ST. JOSEPH LEAD COMPANY

250 PARK AVENUE, NEW YORK 17 • Plant & Laboratory: Monaca (Josephtown) Pa.



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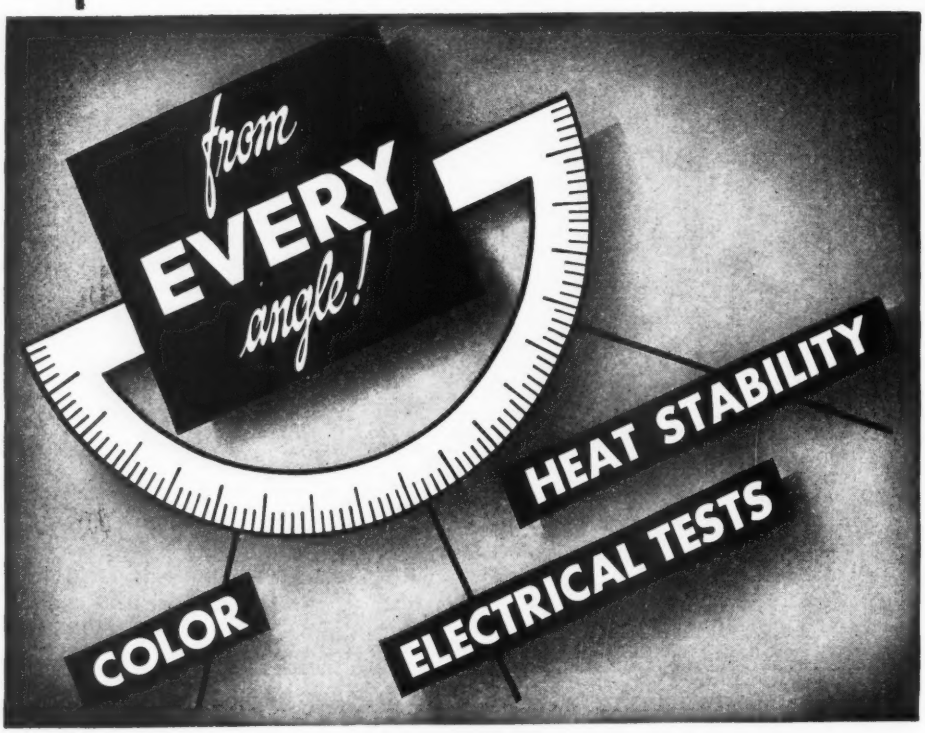

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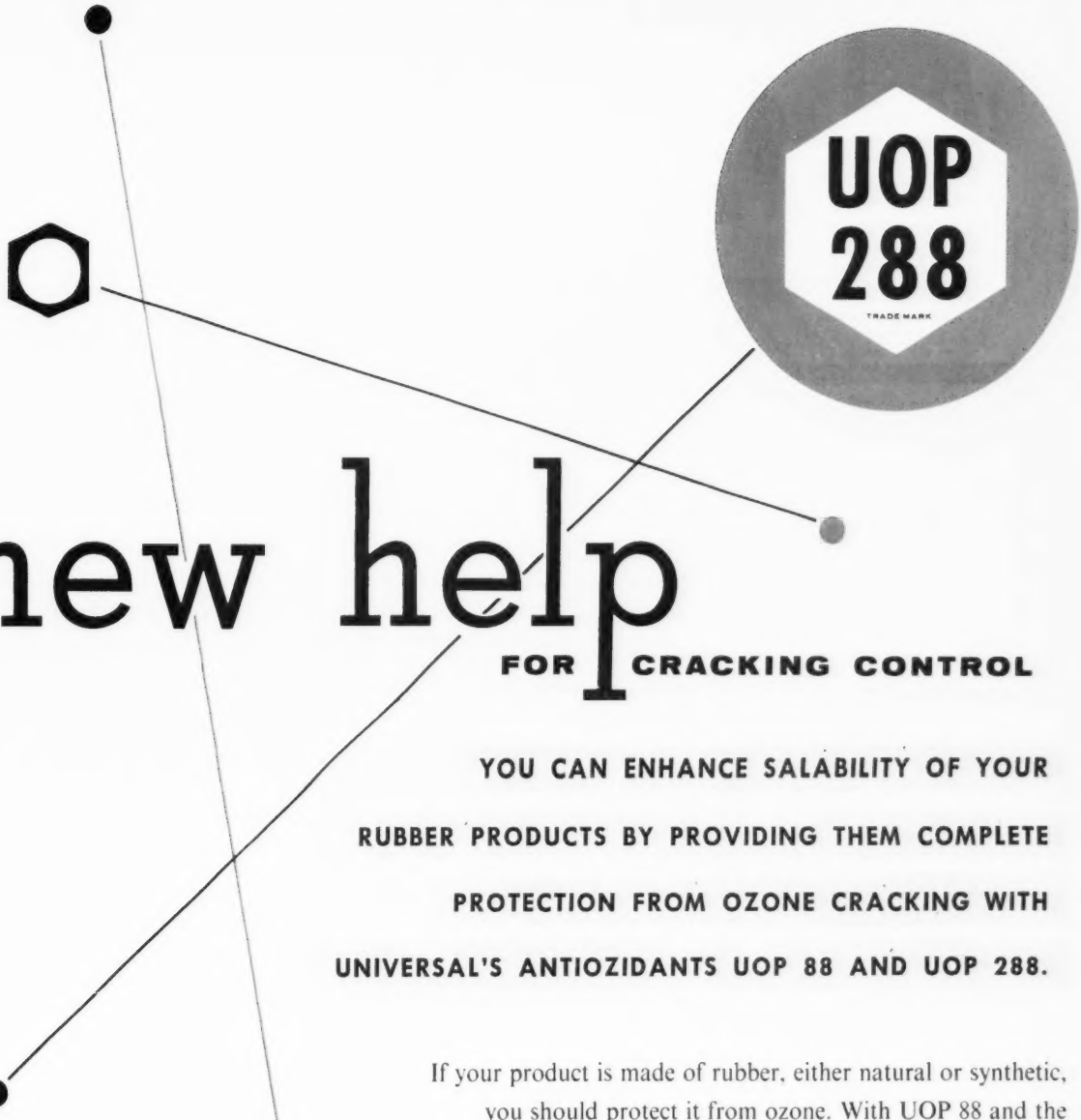

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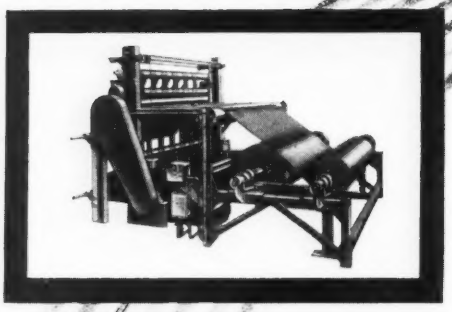

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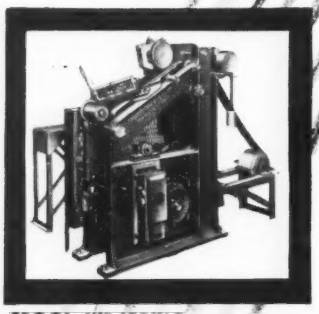

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complete wire-bead CYCLE TYRES in one fast operation

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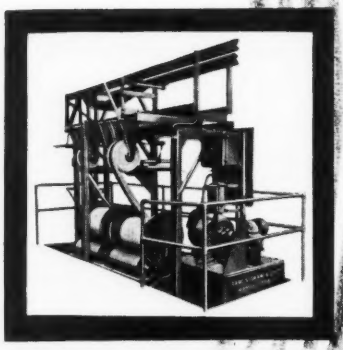

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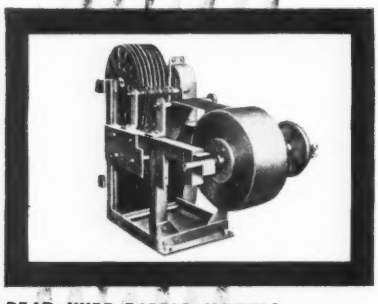
for continuous production



BEAD WIRE FABRIC SLITTING
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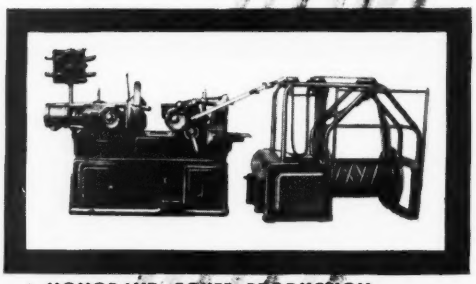

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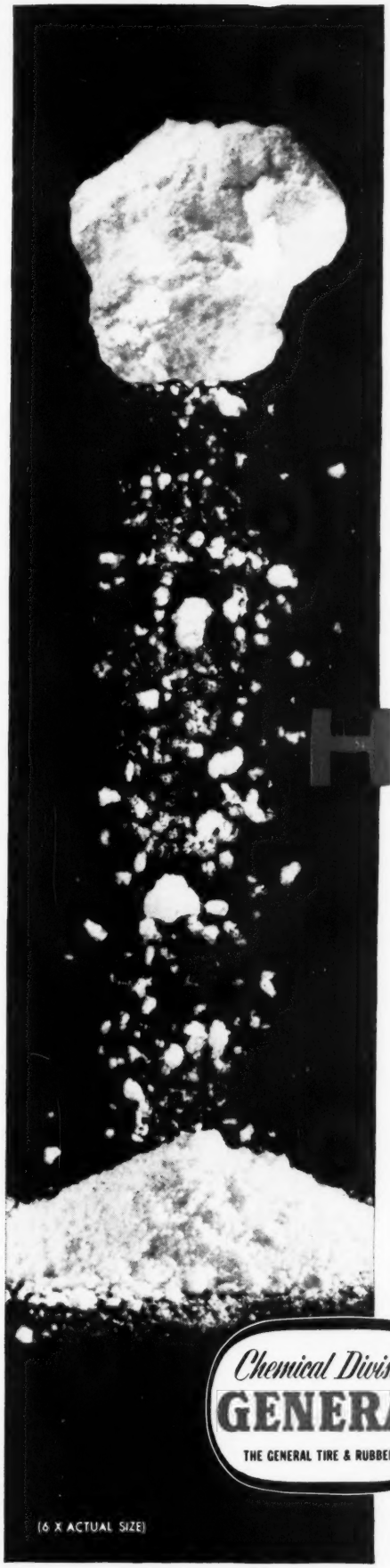

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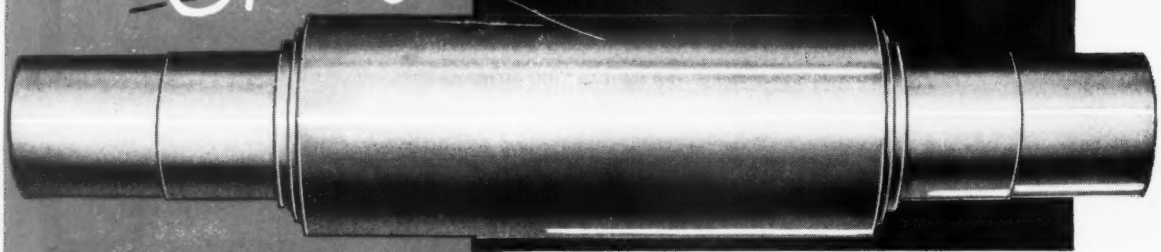

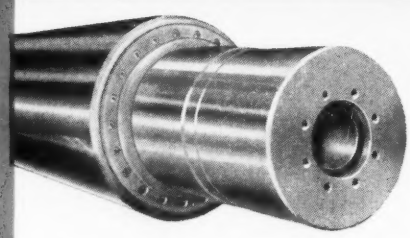

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Synthetic Rubber Sales Division
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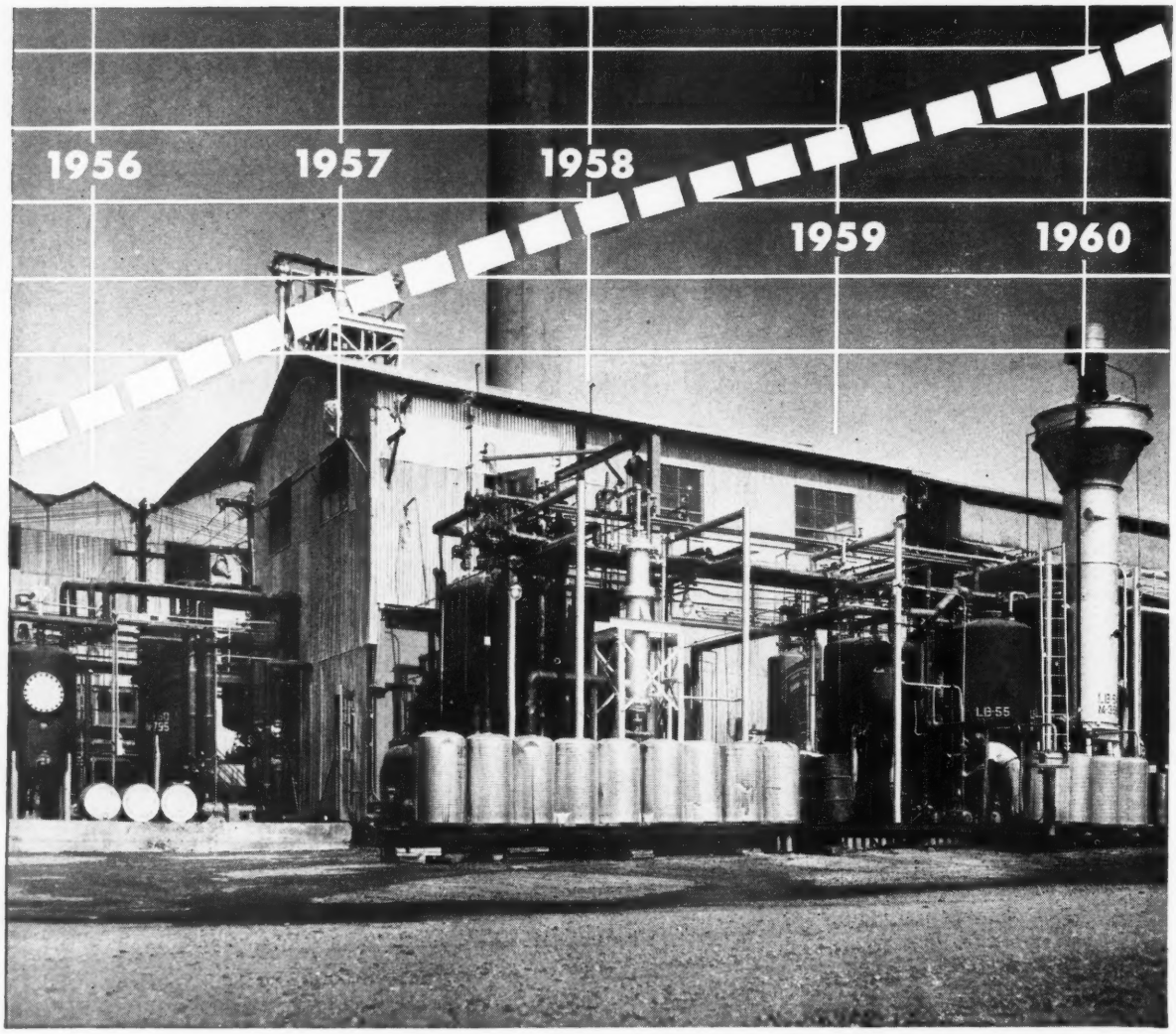
SHELL



LOOKING AHEAD—This pilot plant is typical of Hercules facilities devoted to the development of new products for the rubber industry. Chart of future rubber consumption is projected on the basis of government statistics.

Hercules Facilities Keep Pace with Rubber Industry's Growth

This new pilot plant at Hattiesburg, Mississippi helps pave the way for new and improved rubber chemicals for tomorrow.

Hercules has pioneered in the development of Dresinate® rosin soap emulsifiers, and other products such as hydroperoxide catalysts and brick defoamers. New materials, the result of continuing research by Hercules, are now being readied for commercial production.

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PR56-1

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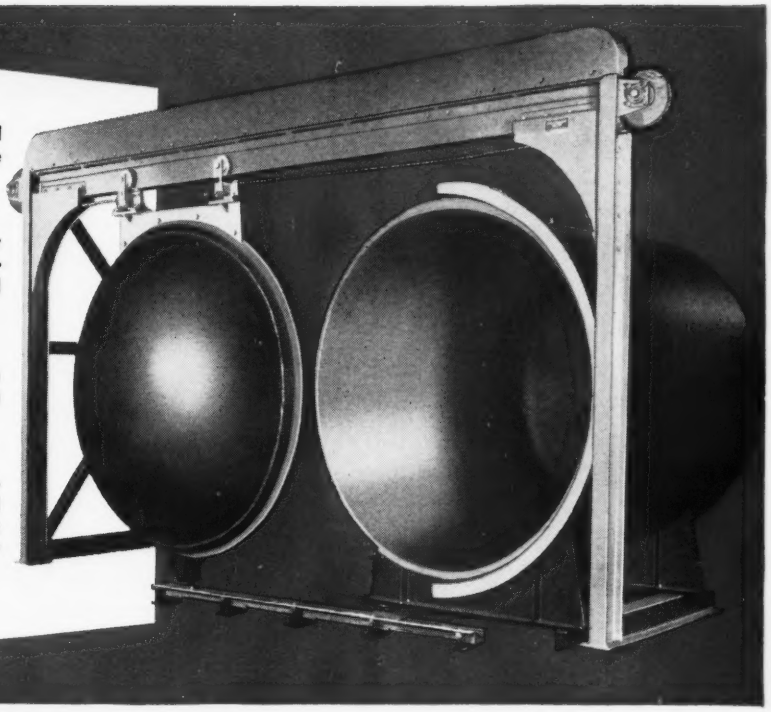

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Products for the rubber, plastics and plywood industries by ADAMSON UNITED

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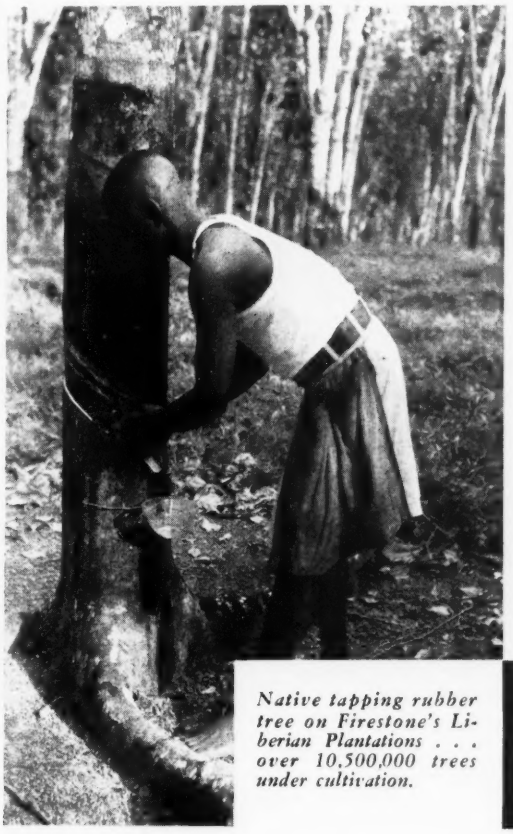

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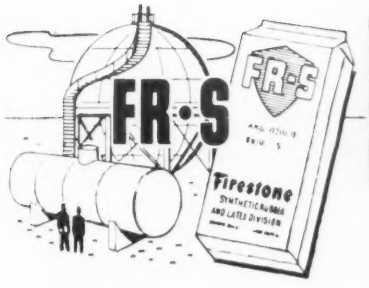

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In collaboration with other Societies, it aims to raise the standing of the Industry throughout the world by improving the technical qualifications of its personnel, extending the study of its raw materials, processes. and products, and by promoting the exchange of technical discovery and information by means of literature, conferences, and meetings.

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New Copolymer For You?

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These are just three of many quality Koppers Chemicals; and we have been able, here, to give only the briefest sketch of the ways in which you may be able to use them. We are able and anxious to give you more specific information. Call the nearest sales office or write to Koppers Company, Inc., Chemical Division, Dept. RW-86, Pittsburgh 19, Pennsylvania.

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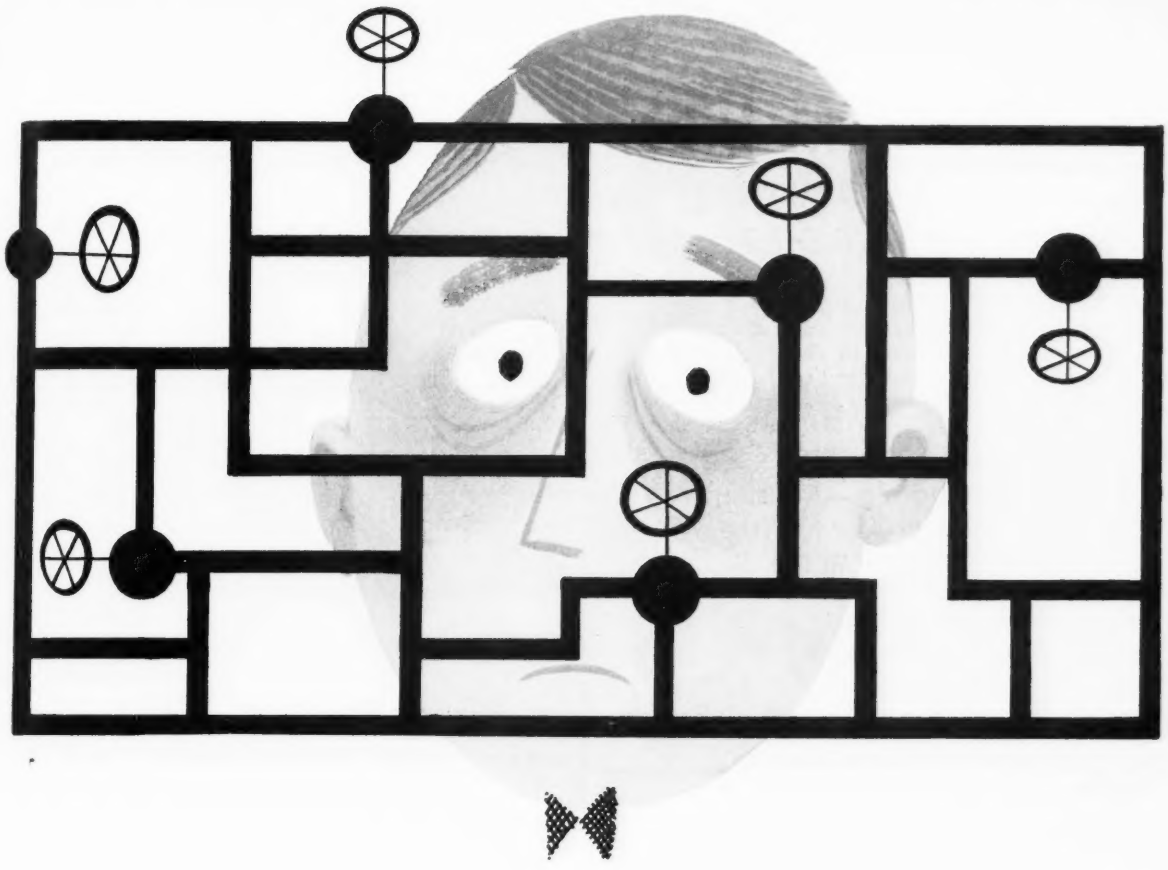

try **Velsicol** *hydrocarbon resins*

If processing worries follow you home and haunt you, it's time you had a chat with your Velsicol Representative. He's a qualified chemist, who can explain how manufacturers of rubber compounds have improved calendering, milling and curing characteristics with Velsicol Hydrocarbon Resins. He can supply samples for trial work, and acquaint you with the services of the Velsicol Resins Laboratory. Contact him soon. There's no obligation involved—just opportunity.

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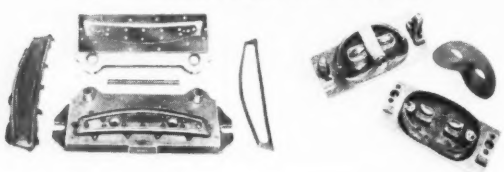

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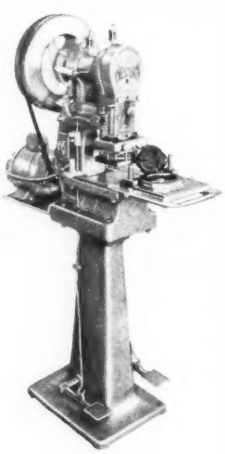

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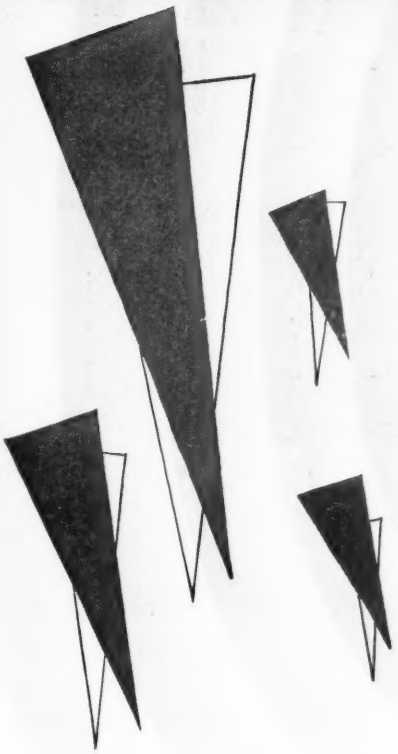

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For GR-S and Natural Rubber

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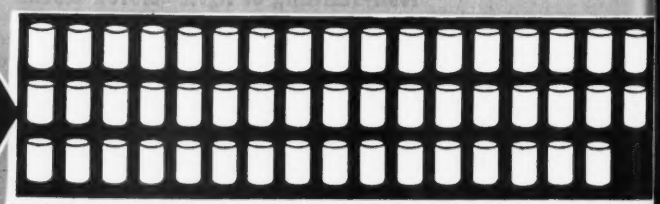

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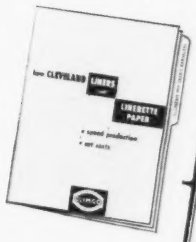

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Manufactured by Stabelan Chemical Company.

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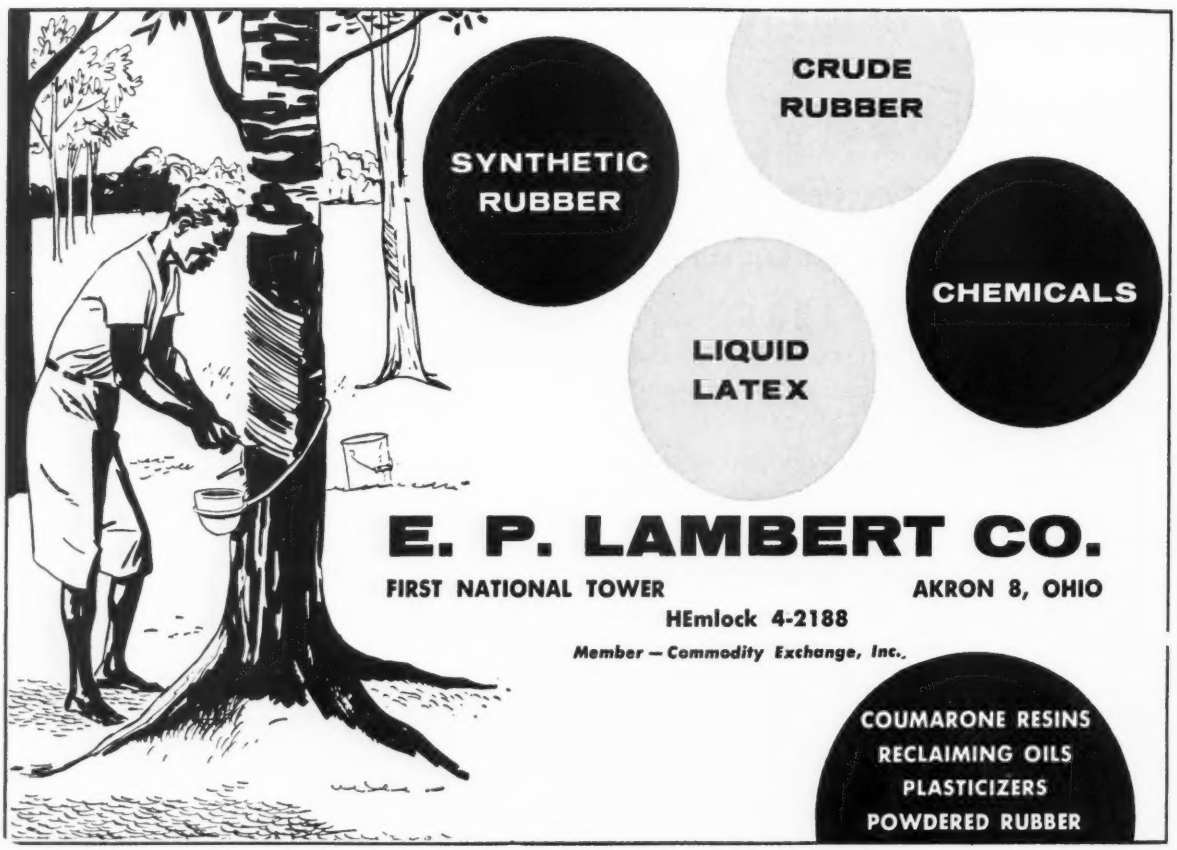

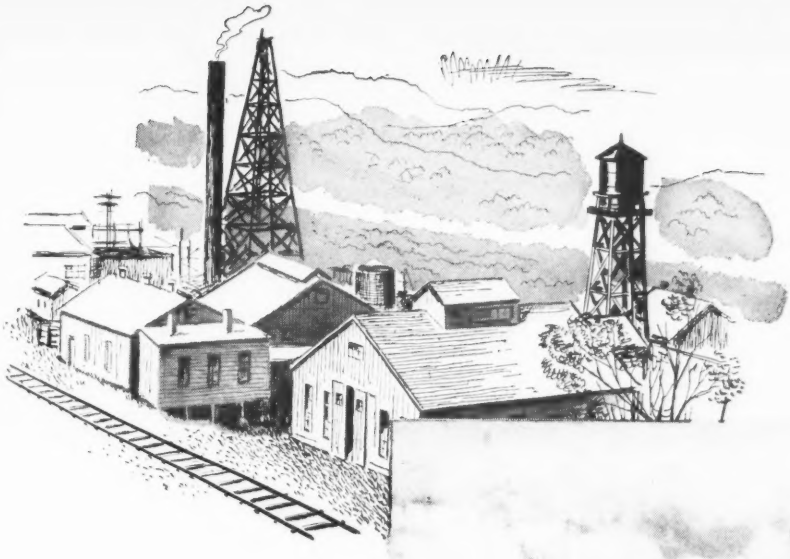

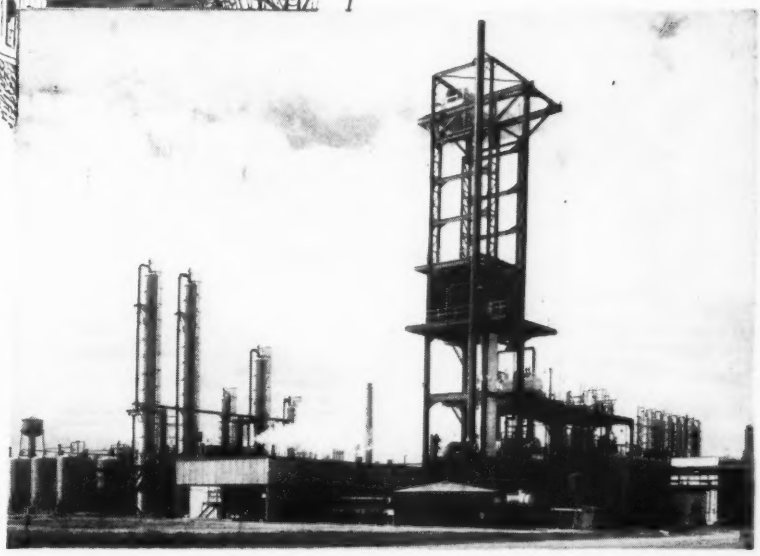

design makes a difference . . . . . *and*

FLEXOL PLASTICIZER 10-10 *is designed for low volatility*

Trade Mark

In plasticizers as in chemical plants, design is important. CARBIDE's Oxo unit at Texas City, Texas, shows progress in plant design from our original plant at Clendennin, West Virginia. And primary decyl alcohols from the huge Oxo unit are used in making FLEXOL Plasticizer 10-10 (didecyl phthalate), CARBIDE's newest plasticizer.

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You will find that FLEXOL 10-10 provides additional performance characteristics in your calendered film and sheeting, profile extrusions, electrical insulation, coated fabrics, slush-molded or dip-molded articles, and other vinyls that require low volatility.

Continuing progress in raw materials production enables CARBIDE to design top-quality plasticizers for you. Our basic raw materials position also means a continuing supply of 10-10 in the quantities you need.

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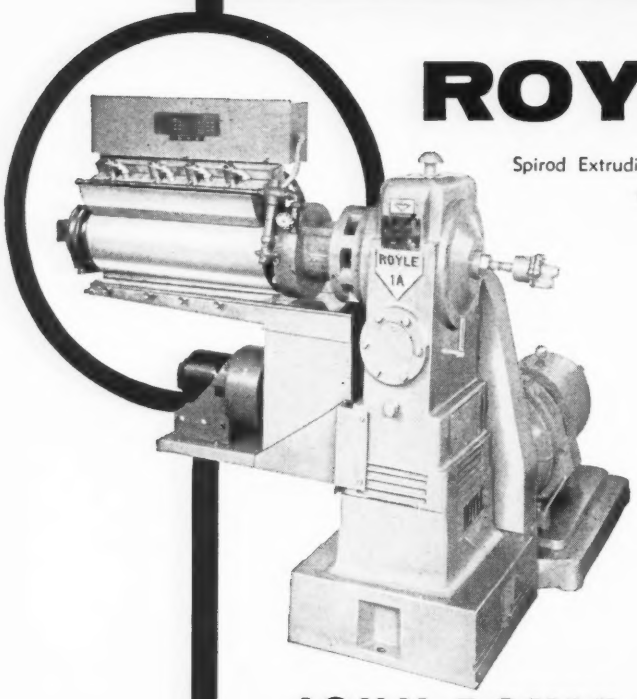
The term "Flexol" is a registered trade-mark of Union Carbide and Carbon Corporation.



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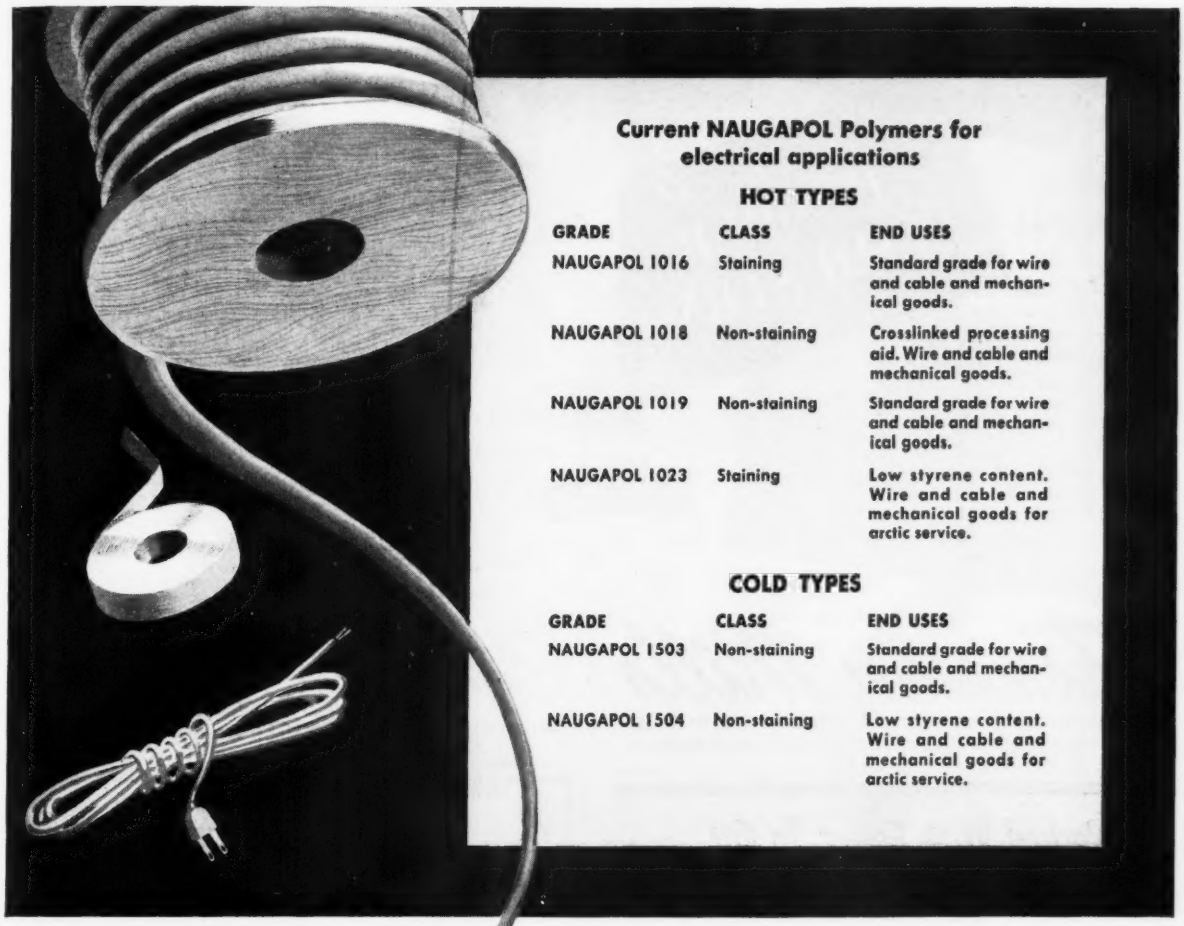
Naugatuck Naugapol



Current NAUGAPOL Polymers for electrical applications

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GRADE	CLASS	END USES
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NAUGAPOL 1018	Non-staining	Crosslinked processing aid. Wire and cable and mechanical goods.
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GRADE	CLASS	END USES
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Naugatuck answers wire and cable insulating problems with Naugapol

For products requiring excellent electrical properties and for those items designed for low moisture absorption, NAUGAPOL, butadiene-styrene copolymers, "Specially Processed" during the finishing operation, is the best obtainable.

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Division of United States Rubber Company
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US RUBBER

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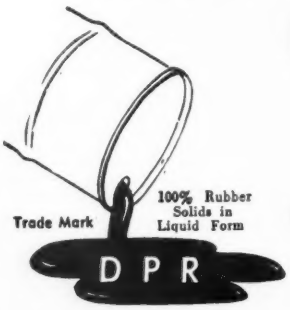

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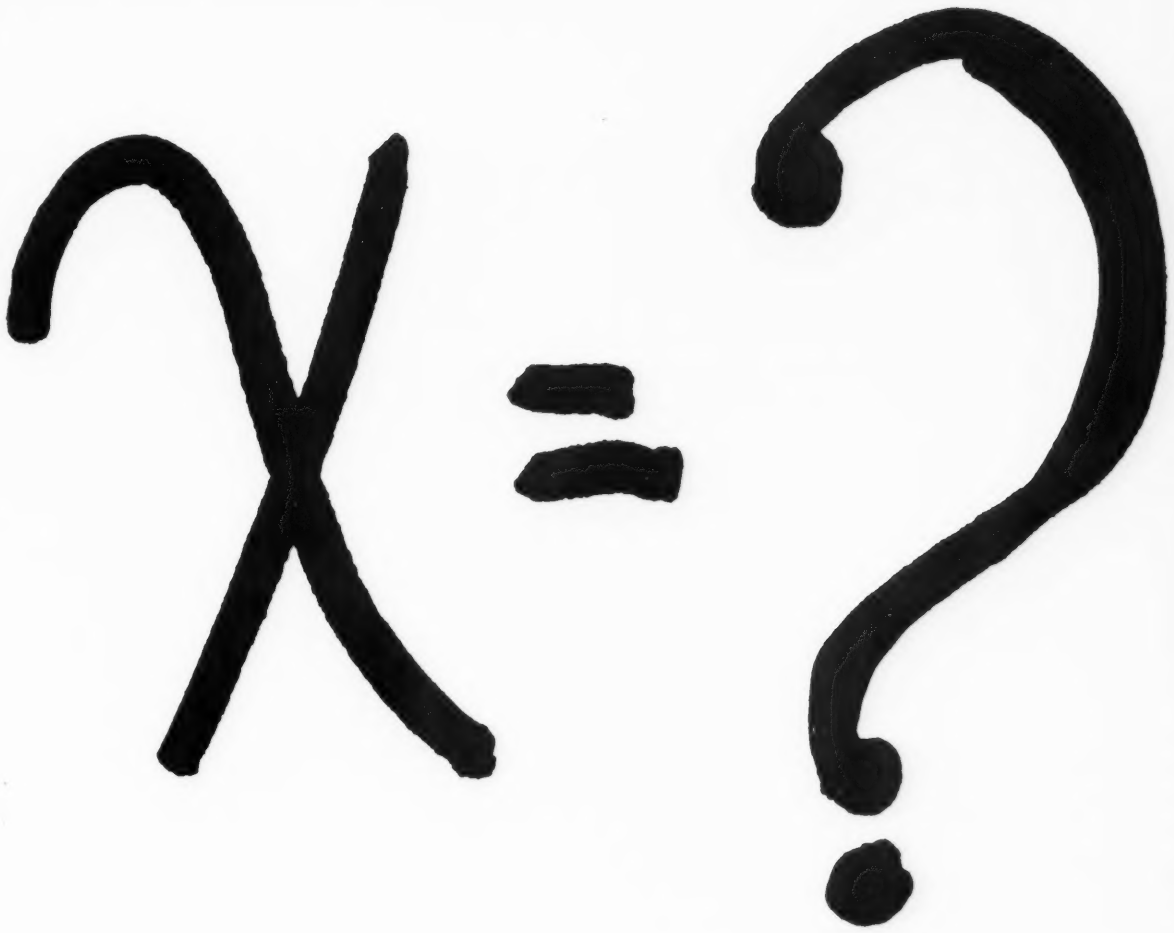

Answering Questions About Rubber Formulations Is Our Business

Sometimes the answers are so simple, we are surprised ourselves! Like the time a certain rubber processor brought us this one:

The Problem: What is the best non-staining antioxidant for a 55 Durometer natural rubber stock with a heavy whiting load?

Here's What Monsanto Compounders Did: Compounded a pale crepe stock with 100 parts of whiting . . . added Santowhite Crystals and also test batches including two other good commercial antioxidants.

The Results: Formulation with Santowhite Crystals showed best aging by a wide margin.

Better performance is the only way we sell. Sure, our crystals and powders are pure and pretty. But customers buy our rubber chemicals because they work not only in the laboratory, but on the production line.

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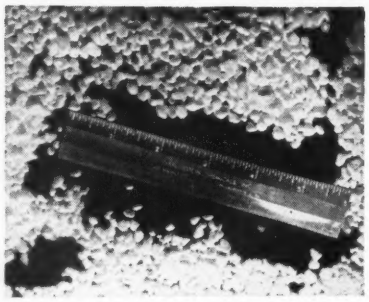
To Eliminate Dust and Cut Costs

IN NEOPRENE COMPOUNDING

Use DCI

"Tested and Proved"

GRANULAR LIGHT CALCINED MAGNESIA



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Additionally, protective packaging seals out dust and moisture. All of this means you get the important qualities in magnesia for neoprene compounding without paying a premium. Ask for a sample today. Test and you'll know. Write:

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does not mean cotton fiber alone

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over twenty years catering to rubber manufacturers

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for large production and quick delivery

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KNOWLEDGE
of the industry's needs

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acknowledged superior by all users are important and valuable considerations to the consumer.

Write to the country's leading makers for samples and prices.

CLAREMONT WASTE MFG. CO.

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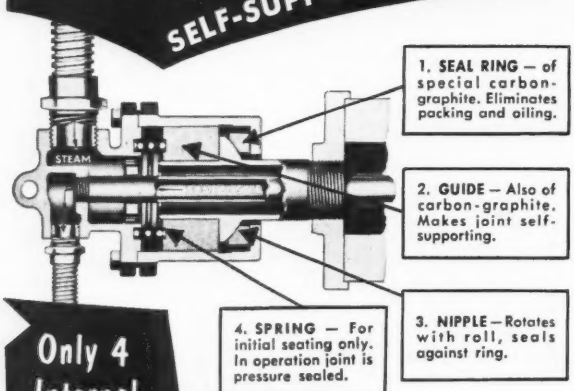
The Country's Leading Makers

JOHNSON Rotary Pressure JOINT

SELF-SUPPORTING TYPE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1. SEAL RING — of special carbon-graphite. Eliminates packing and oiling.
2. GUIDE — Also of carbon-graphite. Makes joint self-supporting.
3. NIPPLE — Rotates with roll, seals against ring.
4. SPRING — For initial seating only. In operation joint is pressure sealed.

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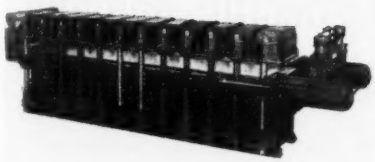

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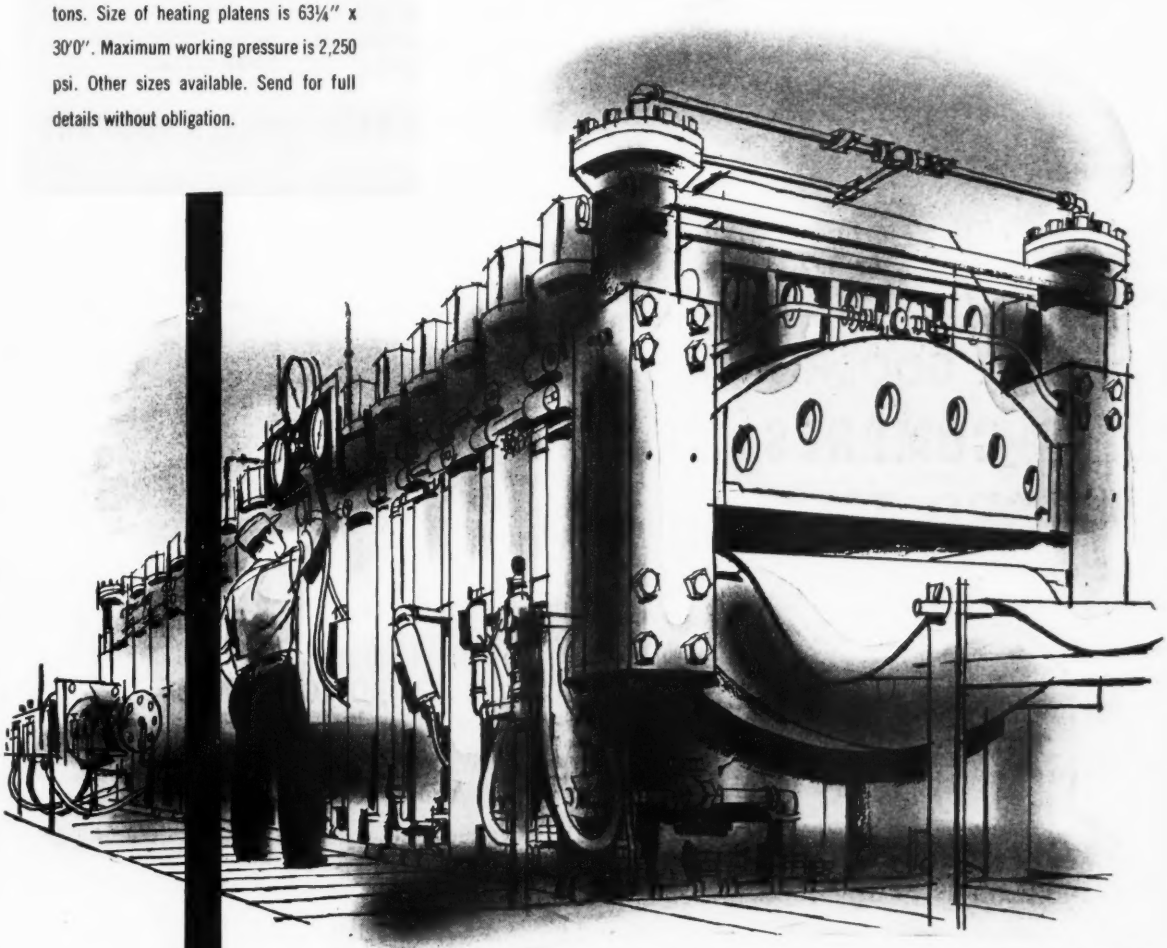

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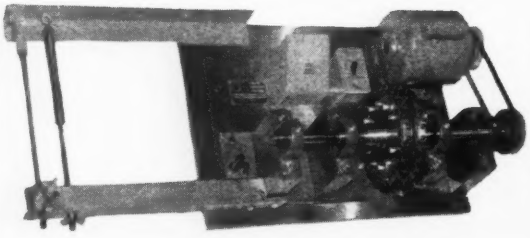

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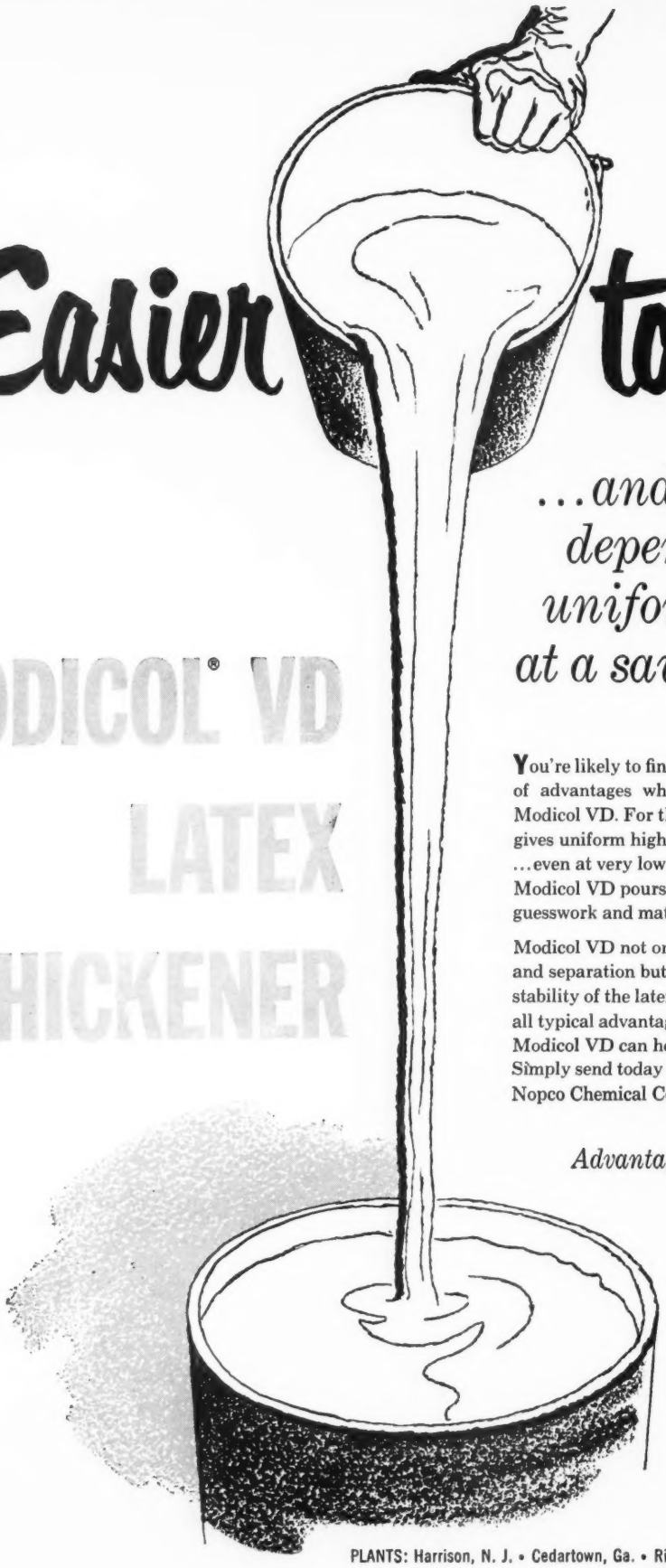

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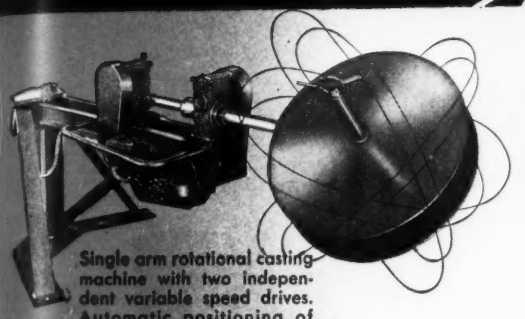

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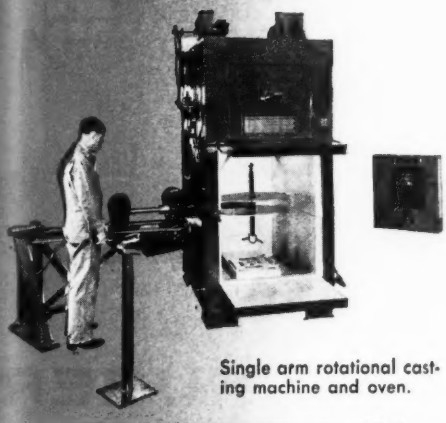

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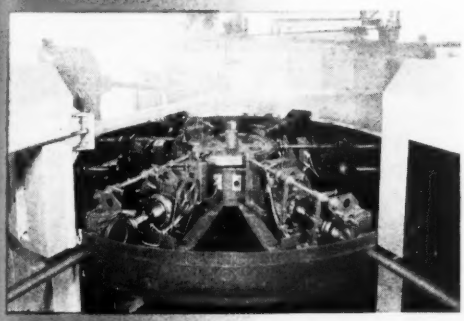

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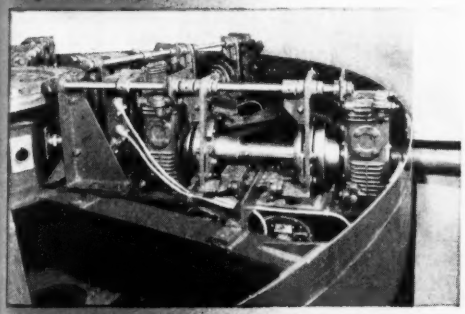

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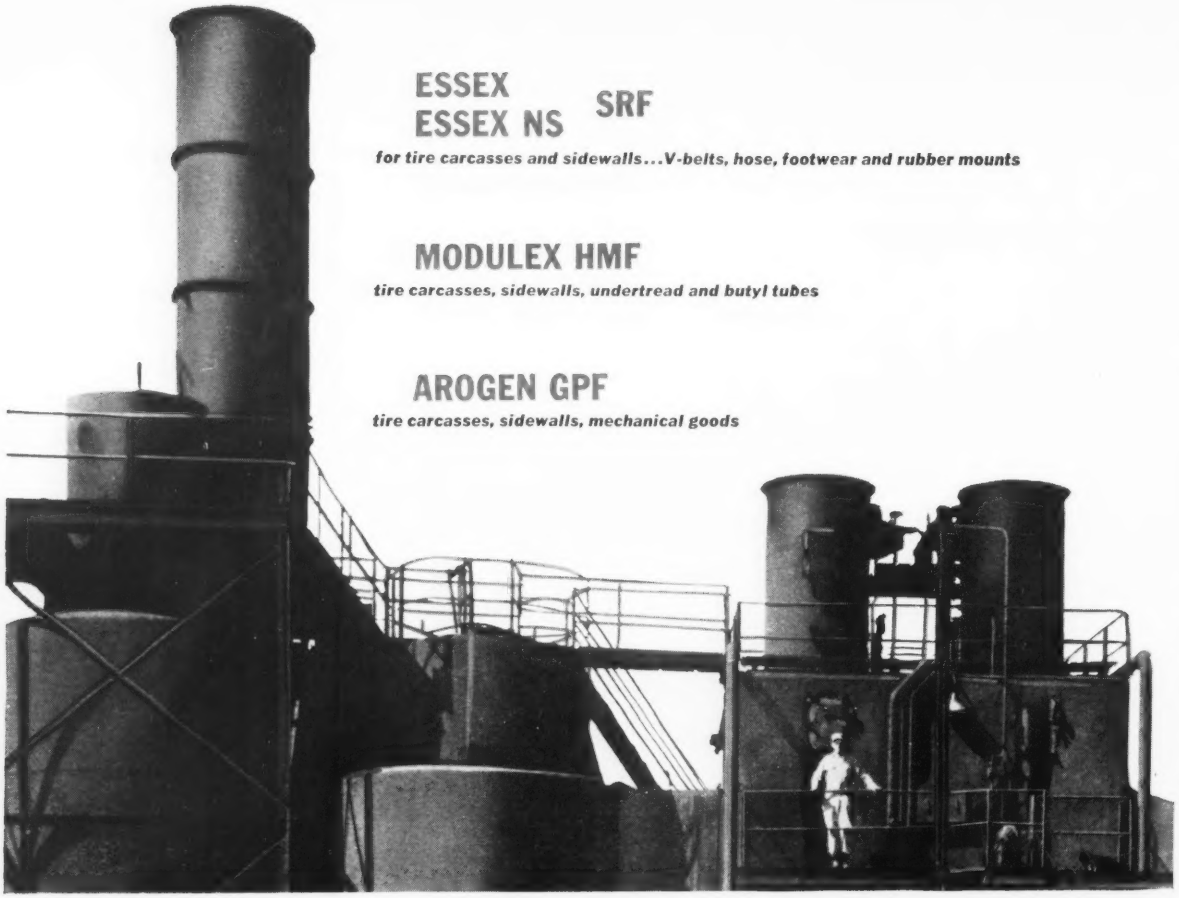

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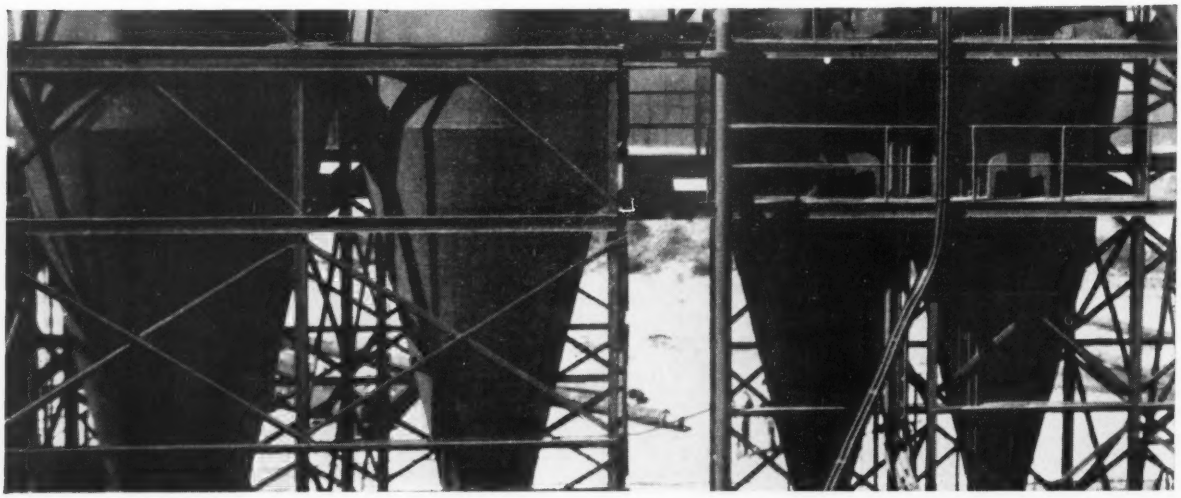

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RUBBER WORLD

AUGUST, 1956

VOLUME 134, NUMBER 5

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THE RUBBER INDUSTRY *IS* VULNERABLE TO ATOMIC ATTACK ..... Neil P. Hurley 697

The vulnerability of the rubber industry by virtue of geographical concentration of plants and work force suggests the need of renewed emphasis on decentralization.

OZONE CRACKING OF RUBBER—OBJECTIVE EVALUATION THROUGH CREEP MEASUREMENT ..... H. M. Leeper and C. L. Gable 703

This ozone resistance test permits continuous, objective, and non-destructive measurement of ozone cracking of elastomers.

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"LITERATURE OF RUBBER" SYMPOSIUM 724

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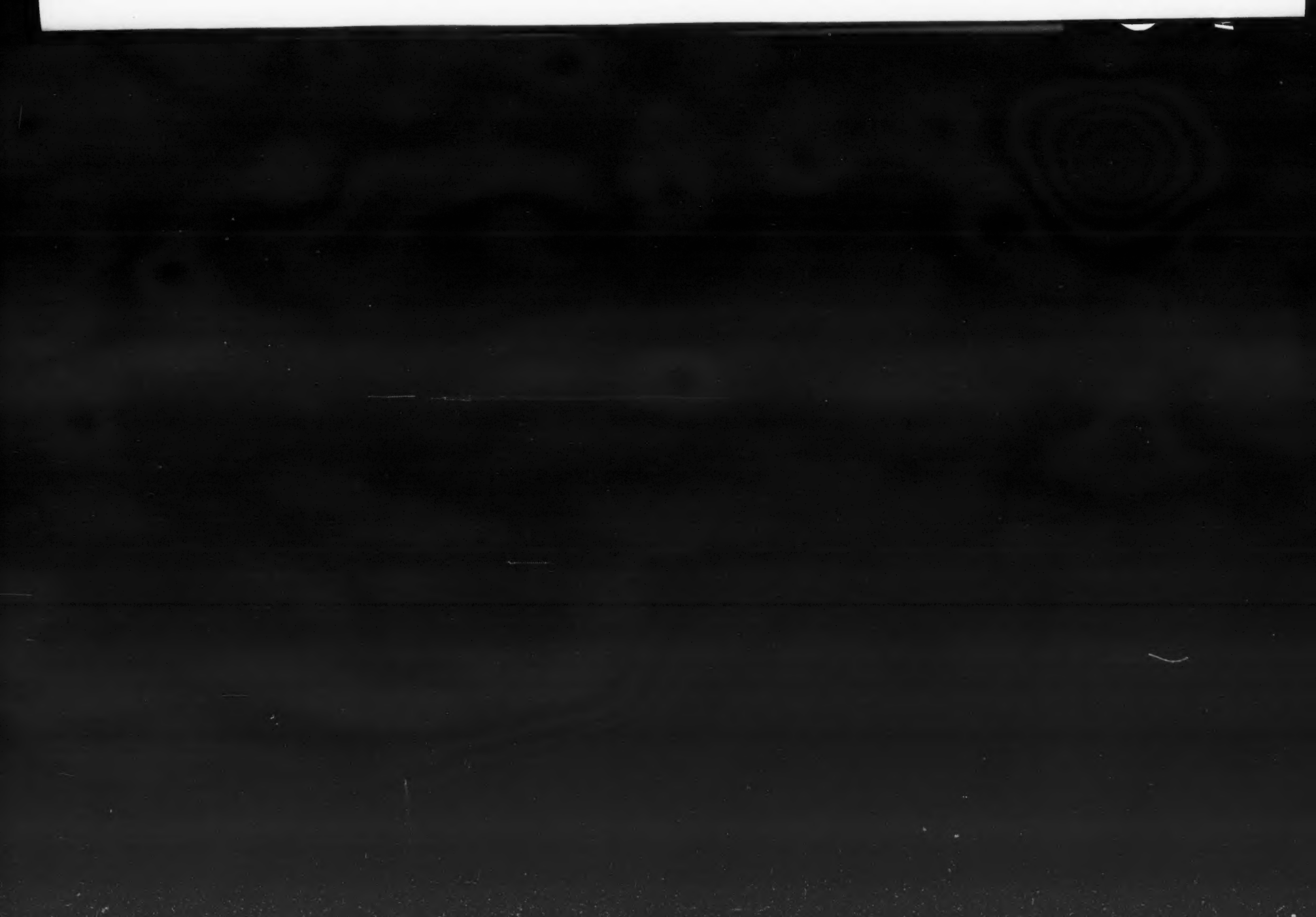


RUBBER WORLD

AUGUST, 1956

Neil P. Hurley

The Rubber Industry *Is* Vulnerable to Atomic Attack

By NEIL P. HURLEY, S. J.
Fordham University, Bronx, N. Y.

The vulnerability of the rubber industry to atomic attack is evidenced by (1) the geographical concentration of synthetic rubber producing and rubber goods fabricating plants; (2) parallel concentration of the work force of these branches of the industry; and (3) geographical concentration of petroleum, chemical, and machinery industries which are vital to the production of rubber goods.

The National Industrial Dispersion Program and decentralization for economic reasons have not been exploited adequately as far as the rubber industry is concerned. The necessity of further work with decentralizing forces, as suggested by the Project East River Report, would seem to be indicated.

IF THE "Operation Alert" attack in June, 1955, had not been a simulated one, but the real thing, six well-directed H-bombs on six of the 57 target sites selected as prime targets would have wiped out two-fifths of the plants and personnel of the rubber industry. Of the entire national employment in the rubber industry, 44.2% is concentrated in six cities as follows:

Metropolitan Area	% of U. S. Total Rubber Employment
Akron, O.	20.6
Boston, Mass.	6.1
Newark-New York	5.2
Los Angeles	5.2
Detroit	3.6
Philadelphia-Camden area	3.5
Total	44.2%

SOURCE: "Industrial Market Planning Workbook," McGraw-Hill Publishing Co., New York (1954).

The 25-mile radius of destruction which marks the limit of incendiary damage for a 20-megaton H-bomb would about cover the metropolitan areas of these rubber-producing centers. Map 1 shows the area of total destruction for a radius of 10 miles in the Akron area.

As was shown in the Strategic Bombing Survey in Europe in World War II,[1] technological economies can be paralyzed in one or more of five ways: (a) destroying the basic producing facility itself; (b) destroying, incapacitating, or diverting the labor force engaged in that industry; (c) crippling earlier stages of production and thus choking the supply lines of subsequent stages in the vertical productive process; (d) disrupting vital communication lines, utilities, electric and power grids, and transportation arteries upon which the industry is vitally dependent; and (e) knocking out industries which are basic suppliers of other industries on the principle that if the root is killed, the branches will also die.

The Basic Industry

The rubber industry is vulnerable in all five ways.

[1] RUBBER WORLD, Feb., 1946, p. 647.

The Author

Neil P. Hurley, S. J., has B.A., M.A., and Ph.D. degrees from Fordham University, the latter two degrees in political science. His doctoral thesis was a study of the nation's non-military defense organization. To date he has completed 15 studies of atomic vulnerability of major industries of the United States.

In connection with these studies he contacted top industry leaders and government agencies including the Office of Defense Mobilization, the Federal Civil Defense Administration, the Department of Defense, the Commerce Department's Business & Defense Services Administration, and the Industrial College of the Armed Forces.

He is a member of the Civil Defense Research Associates and the American Ordnance Association. He sails for Europe in August for four more years of study and research.

The geographic concentration of synthetic rubber plants and rubber fabricating plants makes it relatively easy for an enemy to H-bomb key U. S. rubber plants. Map 2 shows the major synthetic rubber facilities in the nation. It will be noticed that there are 12 locations where synthetic rubber and its raw materials are made at copolymer, butadiene, styrene, or butyl plants. Of these 12 locations, 7 are in littoral states which can be attacked by submarine atomic launchings as well as by air bursts. The cluster of synthetic rubber plants at Houston, Baytown, Port Neches, and Lake Charles represent an irresistible target in the Texas West Gulf Coast region for enemy bombardiers. Baton Rouge, La., is also in the Gulf Coast crescent target range although a considerable distance from the Texas concentrations. Los Angeles on the West Coast, too, is a prime target. The Naugatuck area is on the East Coast; Akron and Louisville are Federal Civil Defense Administration (FCDA) critical target areas.

When we consider that synthetic rubber producing facilities provide about 60% of all rubber consumed in this country, we realize how vital are synthetic rubber plants to the industry and the economy as a whole.

Another weakness from a passive defense viewpoint is the fact that 73% of the rubber goods factories in the U. S. are concentrated in eight states:

State	No. of Plants
Ohio	193
New York	185
California	183
Massachusetts	162
New Jersey	152
Illinois	132
Pennsylvania	100
Connecticut	70
Total	1,177

SOURCE: "Rubber Red Book, 1955-56 Edition," Rubber Age, New York (1955).

Five of these states are in coastal areas accessible to submarine and air attack. Map 3 shows the concentration of plants in 1955, with areas of heavy, medium, and light concentration indicated.

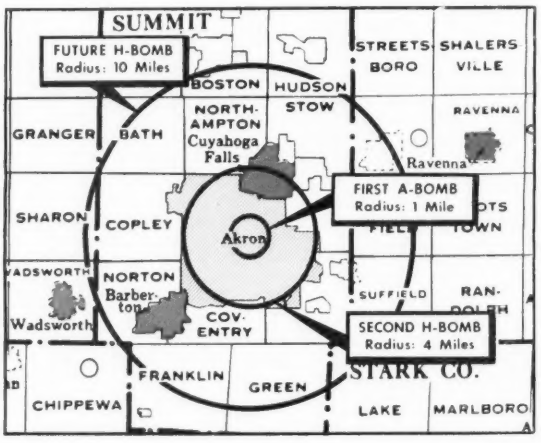
Equally vital in any manufacturing process is the presence of trained personnel. More than 275,000 employes constitute the rubber industry's work force. The average large-scale plant hires about 2,000 employes, most of whom reside within a distance of 25 miles from the plant. The dangers to personnel are apparent.

Here radioactive fallout is significant. For two or three days a downwind cigar-shaped area 140 miles long and 20 miles wide is contaminated. One major rubber plant in Akron employs 14,000. If an H-bomb burst occurred in Chicago or Detroit, rubber production in Akron would undoubtedly be curtailed, if not altogether halted, by two factors: radioactive fallout and the diversion of men and women from surrounding states to take part in rescue work, restoring vital communication and transportation lines, and for general recuperative tasks of an emergency nature.

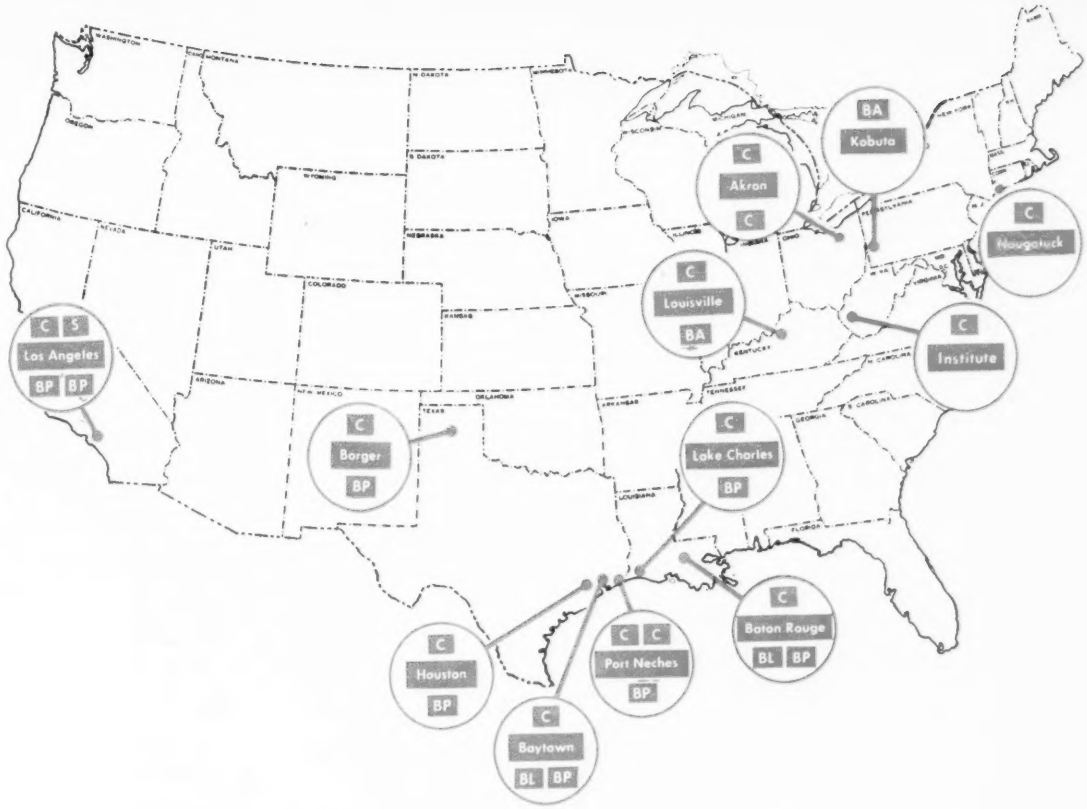
If Akron itself were bombed, 20% of the work force in the U. S. rubber industry would directly be exposed to blast damage, thermal radiation, incendiary action, and atmospheric contamination. Plants can be replaced. Skilled personnel can be replaced only in a matter of decades, even generations. The vulnerability of the rubber industry with respect to its work force is very high.

The Raw Material Situation

Critical raw materials are also vital to industry. If the supply lines of basic materials were strangled, the rubber industry, once inventories were exhausted, would grind to a halt. The fabricating stages of rubber production are dependent upon the earlier stages of raw materials gathering. This dependence makes the industry vulnerable, inasmuch as the petroleum processing facilities of the country, as basic suppliers of the hydrocar-



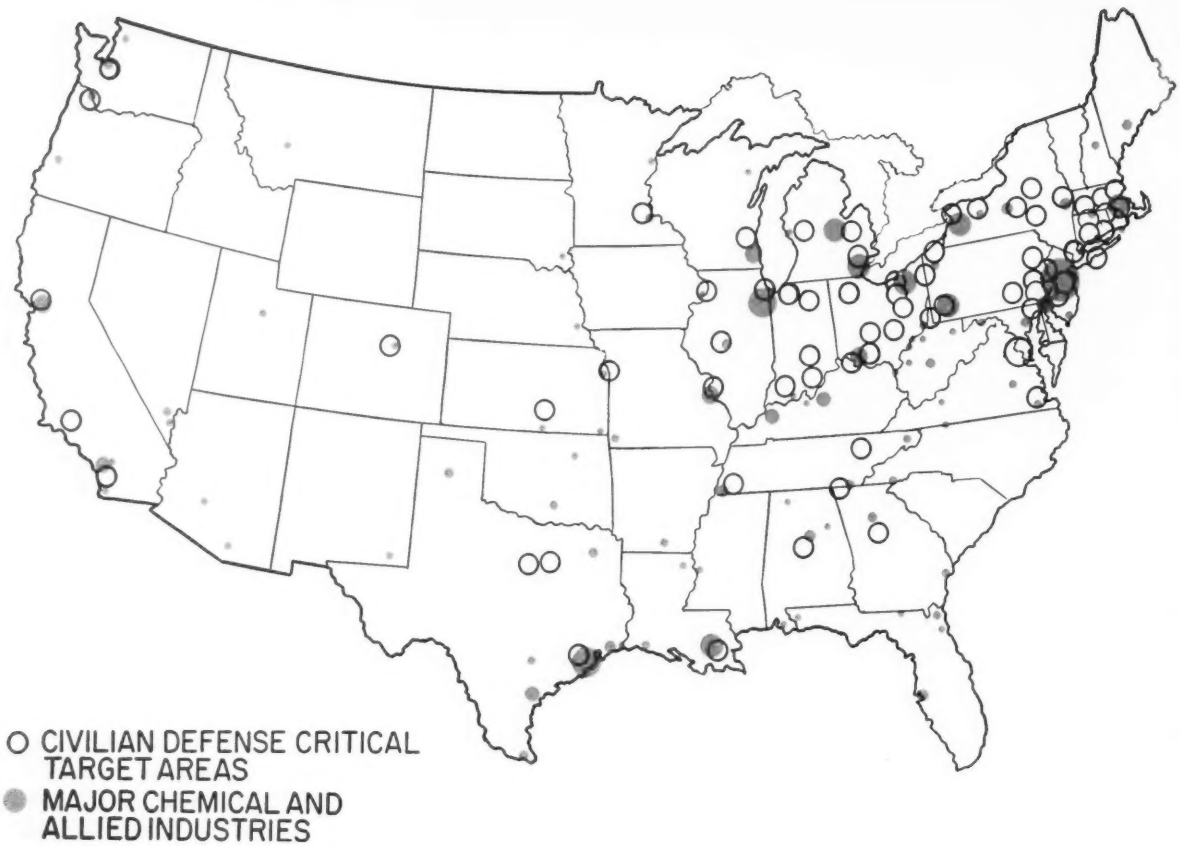
Map 1. Area of total destruction within a 10-mile radius from the center of Akron that would result from a 20-megatron H-bomb



Map 2. Location of major styrene-butadiene synthetic rubber facilities in the nation*

Map 3. Concentration by states of rubber goods fabricating plants in the United States. Solid color, heavy concentration (100-200 plants); dark cross-hatched, medium (50-100); light cross-hatched, light (50 or less)

* Map from RFC report of Mar., 1953, "Program for Disposal to Private Industry of Government Owned Rubber Producing Facilities."



Map 4. Relation between Civil Defense Administration's critical target areas and location of major chemical and allied industry plants†

bons and carbon black for rubber producers, are concentrated and exposed.

Since the advent of synthetic rubber in World War II, the destiny of rubber manufacturers is wedded to that of petroleum processors. Butadiene and styrene are petroleum products; butyl rubber is derived from oil-refining gases, isobutylene, and isoprene.

The table below shows the concentration of petroleum processing plants in four regions, revealing their vulnerability.

Region	Petrochemical Plants		Refineries—% of U. S. Total Capacity
	No.	%	
Houston-Beaumont	34	27.0	21.2
Los Angeles	9	7.1	8.1
Philadelphia	8	6.3	8.1
San Francisco	7	5.5	5.1
Total	58	45.9	42.5

A similar situation exists with carbon black. Ninety-five per cent. of all carbon black sold in the nation goes to the rubber industry. Derived from natural gas or petroleum oils, carbon black is made mainly in the more than 60 plants clustered about 20 gas fields. The largest concentration is in the area where the Panhandle of Texas jigsaws into the Panhandle of Oklahoma. If the carbon black plants in this small compass were bombed, later stages of rubber-fabricating would be disrupted.

Since all of the large rubber companies, except one, have headquarters in Akron, the industry is vulnerable indirectly. Top management, technical, and research men locate there. This fact, plus the centralization of production, accounting, and purchasing controls, weakens the defense position of rubber producing plants, depending as they do on Akron.

The chemical industry is also vital to rubber operations. The rubber industry is one of the largest chemical-using industries; in 1953 the tire branch alone consumed 4.22 billion pounds of chemicals.[2] Map 4 shows the proximity of chemical producers to critical target areas. To strike at the chemical industry would be to strike at the rubber industry, considered frequently as a component of the chemical process industries.

The iron and steel industry is a basic supplier for all the large-scale heavy manufacturers in the U. S. Rubber producers would be hard put to find substitutes for iron and steel. Yet they could easily find themselves in this plight since more than 75% of steel-producing

[2] *Ibid.*, June, 1956, p. 426.

† This map courtesy of *Chemical and Engineering News.*

capacity are located in these 10 areas: Chicago-Gary area; Pittsburgh; Youngstown, O.; Weirton, W. Va.; Detroit, Mich.; Baltimore, Md.; Buffalo, N. Y.; Cleveland, O.; Bethlehem-Morrisville area, Pa.; and Birmingham, Ala. Nine of these areas are target zones; while the tenth, the Bethlehem-Morrisville area, is within the 25-mile radius that includes Philadelphia.

The industry, particularly the rubber tire manufacturing part of it, has in recent years undergone a process of growing mechanization. Technological improvements include the "merry-go-round" conveyor, automatic machine-feeding devices, plasticizing and mixing units, and bias-cutting and bead-building machines of improved quality. Add to this list the standard equipment of Banbury mixers, milling machines, calenders, and vulcanizing equipment, and one readily sees the reliance of rubber manufacturing upon heavy-machine and equipment producers.

Unfortunately, in the Great Lakes region are clustered 47% of the nation's electrical machinery manufacturing plants and 40% of the non-electrical machinery production. Automatic devices, feedback mechanisms, and electronic controls, all becoming more common in rubber manufacturing, are produced in a large measure by four areas: Chicago-Gary, Newark-New York, Rochester, and Minneapolis-St. Paul. In these four metropolitan areas are found 52.1% of all the nation's employes in the production of instruments and related products.

Summing It Up

The rubber industry can be disrupted in four ways: (a) much of the industry is concentrated in one region where much of the research, skill, and corporate operations are centered; (b) personnel live near the area of Akron and other large rubber plants, making the industry vulnerable by possible loss of life and diversion from rubber producing to recuperative tasks of an emergency nature; (c) bottleneck operations are common within the industry; the reliance on petroleum products for synthetic rubber and carbon black links petroleum's high degree of atomic vulnerability to that of the rubber industry; and (d) the rubber industry has a relation of functional interdependence with six critical and highly vulnerable industries: electric generating plants; chemical companies; aluminum, iron, and steel facilities; the producers of heavy-machinery and equipment (both electrical and non-electrical); and instrument manufacturers.

The example of Germany in World War II proves clearly that the rubber industry is vulnerable from a number of angles.[1] The German rubber industry suffered more from indirect attacks than from direct ones. Air raids on synthetic oil plants, chemical plants, and transportation arteries ultimately cut rubber production to a sixth of its peak production figure of 12,000 tons monthly in March, 1944. Besides this, production declined owing to the diverting of employes from direct rubber production to tasks such as dispersing existing facilities, putting new ones underground, cannibalizing badly stricken plants, and camouflaging factories. These factors, plus direct raids on synthetic plants at Huels, Ludwigshafen, and Leverkusen and harbor blockades to prevent the importation of natural rubber, created serious inroads on military requirements, especially in the tire field.

The U. S.'s rubber industry is even more vulnerable than Germany's. First of all, there is a decided concentration of rubber plants in Akron, and of synthetic plants in littoral areas. Secondly, a modern 20-megaton H-bomb carries seven times more energy release than the 2,700,000 tons of bombs which the air forces of the Western allies dropped throughout the entire Second World War.

Recommendations for Dispersal

The U. S. Government understands the vulnerability of key American industries. In August, 1951, President Truman announced the National Industrial Dispersion Program which was designed to "scatter" as much as possible new defense industries. As part of the Korean mobilization program, this was supposed to encourage new defense facilities to settle outside of potential target areas which were determined by local dispersion committees in accordance with norms set up by the Area Development Division of the U. S. Department of Commerce. An incentive to dispersal was found in the defense contracts and defense loans. In August, 1952, one year after the President's promulgation of the policy, the rapid tax write-off privilege was employed to stimulate safer patterns of industrial location.

Tax Amortization

Thus a new defense contractor had to have the location of his new plant approved by the local task force before he received a certificate of necessity. Tax amortization benefits were awarded upon certification. In order to administer the program, however, and to fill the open mobilization goals, certain arbitrary criteria were established. Thus dispersal criteria did not apply to those facilities (a) which were estimated by the applicant to cost less than $1 million; (b) on which construction had already begun; (c) the location of which is not optional, such as mining, oil, natural gas, and hydroelectric power; (d) which have no fixed location such as ships, rolling stock, etc.; (e) which are underground such as pipelines; and (f) which are not in excess of 50% of the capacity existing at the site, provided that such expansion, as estimated by the applicant, does not exceed $5 million.

Also, if the productive capacity of the new facility were badly needed for the defense effort, and the contractor could prove that a dispersed location would cause economic hardship, waivers on dispersal requirements would be granted. Thus in those industries which historically are concentrated for economic reasons, waivers were often granted. This was true to a large extent of iron and steel companies, aircraft companies, and metalworking firms. Industries with observable decentralization trends had good dispersal records as determined by the arbitrary criteria of the office of Defense Mobilization.

Economic Decentralization

Fortunately, the rubber industry has been decentralizing for economic reasons. The leading rubber companies, according to the 1948 NICB's report, "Decentralization in Industry,"[3] are deploying their facilities to serve adequately all areas with a minimum of cost and time. The rubber industry first put plants on the West Coast, and now is adding them in the East, Southeast, Midwest, Southwest, and Pacific Coast.

With automobile assembly plants oriented to population distribution, the tire plants are seeking out locations near the new market areas in order to meet the growing demand for original equipment on new cars as well as the replacement demand. Thus there is a double pull to the new market areas: the needs of the assembly plants, and the area's needs of replacement tires. Other factors in the decentralizing forces at work in the rubber industry are availability of labor, segregation of unlike products, more effective managerial control possible in smaller plants, and better labor relations outside Akron. Though Akron is still the rubber capital of the world, present indications are that a greater share of the industry's output will come from outlying plants.

A *Business Week*[4] report shows that the shift of rubber companies to new regions has been relatively slight; 50% of postwar rubber industry's new construction has been in the Great Lakes states—one-third in Ohio alone. Between 1947 and 1954 the Great Lakes region's share of new rubber plant construction fell only 3%. The migration has been mostly to the Pacific Coast and the Far West areas.

Decentralization for economic reasons can serve strategic defense purposes if properly directed. New target areas are now arising in the newer regions. Examples of budding metropolitan areas with growing industrial and population concentrations are Miami, Tulsa, Oklahoma City, Baton Rouge, Phoenix, Albuquerque, Galveston, Port Arthur, Salt Lake City, Des Moines, and Spokane. The accelerated amortization device of the government could do little in the face of the socio-economic pull to the suburbs and semi-rural areas. The best hope for scattering atomic targets and making them as functionally independent as possible is to harness the natural decentralization forces which are currently operative.

Dispersal is a necessary defense measure. To date its value as a pre-attack deterrent to atomic attack has not been exploited. If we have few "sitting ducks" throughout the nation, it will be manifestly clear to any enemy that an atomic Pearl Harbor would be foolhardy.

[3] National Industrial Conference Board, New York (1948).
[4] Aug. 13, 1955, pp. 78-96.
[5] "Report of Project East River." Associated Universities, Inc., Brookhaven National Laboratory, Upton, N. Y. (July, 1952).
[6] Review of Project East River by 15-man committee headed by Otto Nelson. Associated Universities, Inc., Brookhaven National Laboratory (1955).
[7] Three volumes: "Safety Plan," "Defense Security Plan," "Industrial Mobilization Plan." Koppers Co., Inc., Pittsburgh 19, Pa. (1954).
[8] "Iron and Steel Defense Planning Manual." United States Department of Commerce, Business & Defense Services Administration, Washington, D. C. (1954).
[9] Emergency and Disaster Planning for Chemical and Allied Industries. U. S. Department of Commerce, BDSA (1953).
[10] National Petroleum Council, Washington, D. C.

Surveys Available

At a time when the government is revising its dispersal yardstick and trying to cope with modern weapons effects and the radioactive fallout threat, it might be well for federal officials to reread the May, 1952, report of the Project East River Commission[5] which was set up to study means of abating concentrating pulls in American communities and industrial areas, and the 1955 review of this report.[6] If some feasible plan of "satellite town" planning were adopted in accord with the recommendations of the Project East River report, then the decentralization trend could be directed in order to effect more immune, as well as more humane, ecological patterns. Thus would the extreme functional interdependence among so many vulnerable industries be mitigated—not perhaps next year or the year after, but in a decade or two.

The American rubber industry can protect itself in many ways. There is a growing list of defense-planning manuals geared for specific industries. Thus the Koppers Co.[7] has prepared its own company disaster-planning booklets. The American Iron & Steel Institute, in accord with a request of the U. S. Department of Commerce, has published its "Industrial Defense Planning Manual—Iron and Steel."[8] The rubber companies might derive real profit from the suggestions contained in the U. S. Department of Commerce's "Emergency and Disaster Planning for Chemical and Allied Industries."[9] Also valuable are the comments in "Security Principles for the Petroleum and Gas Industries"[10] and "Disaster Planning for the Oil and Gas Industries,"[10] both published by the National Petroleum Council. Though these manuals mention dispersal, their recommendations treat primarily with post-attack measures.

Dispersal has been stressed here because of its urgency, and the fact that practical suggestions have not been forthcoming from specific industries. Dispersal of existing industries is definitely out; so, too, is dispersal which is contrary to the normal economic factors of doing business profitably. However, owing to the lack of coordination among interested parties (e.g., architects, real estate boards, city planners, builders, union and corporate officials, representatives of the city, and state and federal governments) the passive defense value of plant locations and community developments which have spontaneously arisen has been slight. Houston is an example. Only 10 to 20 years ago a small city, it is today a huge target and petrochemical center. Proper planning can prevent future Houstons.

Despite its age, the following recommendations of the Project East River have relevance today for aiding population and industry in "leap-frogging" out to extra-urban areas: (a) federal aid to urban arteries, especially those connecting satellite towns; (b) rent subsidies for a period of time, particularly to small business; (c) government appropriations to match those of metropolitan planning units; (d) tax assistance to all new construction in outlying areas, with special consideration to new and small business; and (e) federal

(*Continued on page 717*)

Ozone Cracking of Rubber—Objective Evaluation through Creep Measurement[1]

By H. M. LEEPER and C. L. GABLE
Monsanto Chemical Co., Nitro, W. Va.

An ozone resistance test has been designed that allows continuous, objective, and non-destructive measurement of the extent of ozone cracking of vulcanized elastomers. The test involves measuring continuous creep of ring specimens.

Data presented results from the outdoor exposure of tire tread vulcanizates containing exploratory antiozonants. Duration of the test varies from one week to one to two months.

It is demonstrated that the observed creep, within the time scale of the experiment, is due almost entirely to ozone cracking as opposed to oxidative deterioration. Reasonably good correlation with other ozone resistance tests was found.

A DECADE has now passed since publication of the classical work of Newton (1)[2] and Powell and Gough (2) on the definition and mechanics of ozone-induced degradation of unsaturated polymer vulcanizates. The undesirable deep fissuring which had long been observed in natural rubber products, and more recently in styrene-butadiene rubbers (SBR), was shown to be caused by atmospheric ozone. Conditions affecting type and degree of deterioration prevailing were carefully studied and catalogued. These findings had important commercial significance, and they lent strong impetus to the development of chemical and physical means for preventing ozone attack. The consequent need of methods of reproducibly inducing ozone cracking and measuring its extent led to a number of published test procedures.

The problem of designing accelerated tests for predicting ozone resistance in actual performance is beset with the usual difficulties associated with development of rubber tests of other types. No single test procedure can be expected to be universally successful in predicting stability against ozone for all applications. For vulcanizates which are used primarily out-of-doors, however, a practical ozone resistance test should incorporate the following factors: (a) objectivity of measurement, (b) close reproducibility of measurement under a given set of conditions, (c) good resolving power among truly existing differences (d) speed, (e) exposure to the elements—rain and light of a spectral distribution likely to be encountered in service.

Shaw and Adams (3) have described a test in which rubber specimens are (a) exposed, while under constant strain, to ozone and (b) subjected to periodic measurement of elongation upon application of a predetermined, fixed load. Rugg (4) has presented a completely objective method of assessing severity of ozone attack. The procedure involves measurement of crack depth by means of optical aids. The test operates satisfactorily under conditions of either constant load or constant elongation of the specimen. The specimen, however, is destroyed in the process of making the measurement.

Creep tests have been extensively used in the study of accelerated deterioration of vulcanizates of many types of polymers under arbitrarily selected conditions. Tobolsky *et al.* (5) described a test in which decay of stress of a thin rubber ring was observed. Throdahl (6) proposed a creep test with practical application to the study of effectiveness of antioxidants. The test employed a constant load, and the continuous increase in elongation of a thin rubber ring at elevated temperatures was used as a measure of the extent of deterioration. Buckley and Robison (7) have reported on the design of a sensitive balance for detecting decay of stress in stretched rubber specimens exposed to ozone.

The rate of decay of stress in a thin rubber thread exposed to ozone has been clearly shown, by Beatty and Juve (8), to be a function of the concentration of the ozone. These authors devised equipment for measuring low concentrations of ozone in air in terms of the relaxation of stress of the cracking rubber thread.

The work reported here involves the use of an ozone resistance test that allows periodic, objective, and non-destructive observation of the extent of ozone cracking. The test operates through measurement of continuous creep of a thin rubber ring, subjected to constant load while exposed to atmospheric ozone.

Apparatus and Experimental Procedure

Specimen

The creep specimens used in this work are died out from flat sheets of vulcanized stock, 0.025-0.030-inch in thickness. They are cut as rings having an O.D. of 1⅞ inches and an I.D. of 1½ inches. Since the ring is cut from a flat sheet and stretched as a band, the tension around the edge corresponding to the inner circumference is greater than the tension around the edge

[1]Presented before the Division of Rubber Chemistry, ACS, Philadelphia, Pa., Nov. 2, 1955.
[2]Numbers in parentheses refer to Bibliography items at end of article.

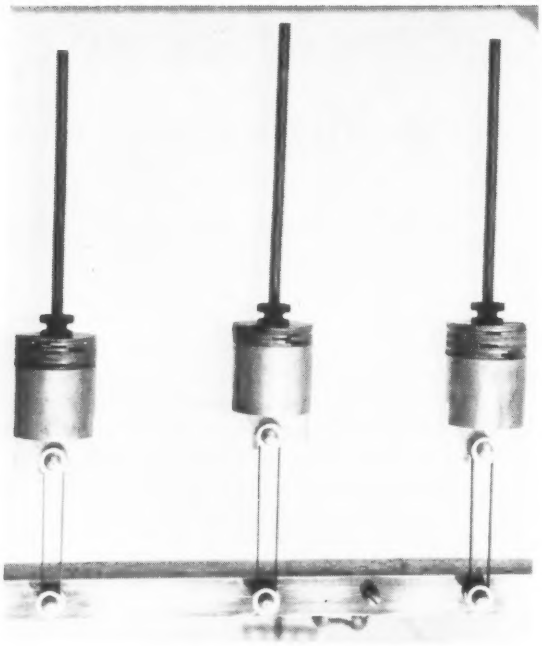


Fig. 1. Simplest apparatus for creep test

corresponding to the outer circumference for all finite degrees of extension. Thus there is a gradation of tension across the width of the band when it is elongated. This condition can be eliminated by cutting the specimen from tubing, but the use of the flat ring is much more convenient and should not detract from the value of the test.

Apparatus

Two types of equipment were used in the measurement of ozone creep. The simplest form of apparatus used is shown in Figure 1. It consists, essentially, of a fixed upper support for the ring specimen and a freely hanging weight to supply dead load. The fixed upper support is comprised of an aluminum bar attached, for rigidity, to a length of ¾-inch galvanized pipe. The latter is threaded at each end to facilitate mounting. On the wide face of the aluminum bar are mounted small aluminum rollers which are free to rotate about their central axes.

The body of the weight is made from 1½-inch aluminum round bar stock. It is cut, as shown, to accommodate a roller identical to those on the fixed support. From the underside of the weight extends a brass screw. The mass of the weight is varied through the use of slotted lead washers which mount on the brass screw and are secured by the knurled nut.

An alternate version of the equipment is shown in Figure 2. As used in the work reported here, the apparatus was housed in a plastic case. In this design the upper support for the creep rings consists of a circular table, mounted near the roof of the cabinet on a central shaft. Small aluminum rollers, as described earlier, are attached to the rim of this table. There are 32 of these, spaced uniformly around the periphery of the table. The table can be rotated from the outside of the plastic case by means of a connecting gear assembly. Thus any particular suspended ring may be quickly brought to the front of the case for measurement of its length.

The weight which supplies the load to the creep rings consists of a cylindrical aluminum tube with an aluminum roller mounted at its upper end. The lower end of the tube is closed with a cap screw, and the mass is varied through the use of lead shot inside the tube. Measurement of length may be made on any given ring by rotating the table until the specimen and weight assembly are directly in front of the permanently mounted vertical scale. The scale is sighted across the flat top of the weights to minimize errors of parallax.

This more elaborate equipment was originally designed for indoor accelerated testing and was therefore enclosed in a plastic case to serve as the test chamber. The apparatus was adapted for outdoor testing by removal of the hinged front door to allow access of the atmosphere to the specimens. The value of this design would undoubtedly be increased if all parts were made of non-corrodible materials to permit complete removal of the plastic case, whose presence tends to prolong the test and shield the specimens from rain and unaltered sunlight.

Both types of equipment gave satisfactory results although measurements are more conveniently and rapidly made with the more elaborate apparatus. Data described in Figures 8 and 9 were obtained through use of the circular creep rack and all other data were derived with the simpler design.

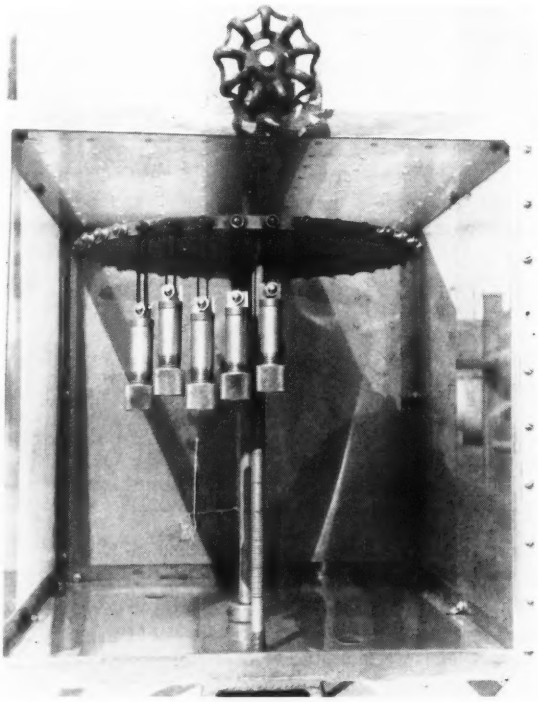


Fig. 2. Creep test apparatus with 32 stations and rotating table

C. L. Gable

H. M. Leeper

The Authors

H. M. Leeper has been a senior research chemist with the Monsanto Chemical Co. at the Nitro Research Department of the Organic Chemicals Division since 1954. As of July 1 he became a group leader in the Research and Engineering Division of the company at Dayton, O. Prior to joining Monsanto in 1954, he had been with the Wm. Wrigley, Jr., Co. for seven years, the Government Synthetic Rubber Evaluation Laboratories for three years, and with the Corps of Engineers as a rubber technologist for two years. Mr. Leeper has a B.S. and an M.S. in chemistry from the University of Akron. He is a member of the ACS.

C. L. Gable has been at the Nitro Research Department of Monsanto since 1952 and is a group leader in elastomer and rubber chemicals applications. From 1948 until 1952 he was group leader in research for Minnesota Mining & Mfg. Co. and was employed by that company from 1941 in various technical capacities. He received his B.S. in chemistry from Wayne University in 1943. He is a member of the American Chemical Society and its Rubber Division, the American Society for Testing Materials, and the Akron Rubber Group.

Experimental Procedure

OZONE CREEP TEST. The test is run, with either form of apparatus, by suspending the weight from the specimen and adjusting the mass such that the length of the stretched ring is approximately 2.8 inches. This distance is measured with a pair of outside calipers and an auxiliary scale. The test assembly is then allowed to rest for 18-24 hours to eliminate most of the primary creep. (The very slight ozone cracking occurring in the blank and poorer stocks during this interval is ignored.)

An initial elongation of 20% over the unstretched length was selected as the starting condition. Dimensions of the test piece and aluminum rollers are such that an over-all length of 3.0 inches corresponds to 20% elongation. The weight is adjusted to produce this condition, and the timing of the test is started.

In the case of the equipment shown in Figure 1, a portable scale is brought to bear against the bottom edge of the aluminum bar so that the position of the scale with respect to the upper end of the specimen is always fixed. The position of the upper surface of the weight against the scale is noted and recorded at zero time. Extent of creep thereafter is recorded at the difference between the initial position of the reference surface of the weight and its position at time, t. The procedure used with the more refined equipment, Figure 2, is the same except that it is not necessary to employ a portable scale, and the readings are taken at a more rapid rate. The test should be run in duplicate and whenever possible in triplicate.

Part of the experimental work involves a study of the correlation of results of the ozone-creep test with those of other ozone-resistance tests used in this laboratory. Three other types of test were used in the comparison, and these tests are discussed briefly below.

INDOOR DYNAMIC TEST. The indoor dynamic test was described by Creed *et al.* (9) and, in its present form, is the same in principle although differing somewhat in treatment of the data. The apparatus consists of pairs of parallel cylindrical shafts, one of each pair being mechanically driven while the other is driven by the specimen which is used as a belt. The specimen is a ring approximately six inches in diameter, ¼-inch in thickness, and ½-inch wide. Only that portion of the belt which is momentarily passing over one of the shafts is strained appreciably, and only then does cracking occur at that position. The entire assembly is housed in an aluminum cabinet in which the ozone concentration is maintained at 25 ±5 parts per hundred million. Ratings of the severity of cracking are made periodically and are entirely subjective, but are quite reproducible from one observer to another.

OUTDOOR INTERMITTENT STATIC-DYNAMIC TEST. This test is identical with the indoor dynamic test except that (a) the test equipment is exposed out-of-doors and (b) the belt specimens are driven only 10 minutes out of each hour through the use of a clock mechanism. The same subjective rating system is employed.

OUTDOOR STATIC TEST. The ring-shaped, molded specimen used in this test has an outside diameter of 2½ inches, a thickness of ¼-inch, and a width of ½-inch. It is stretched over a cylindrical aluminum mandrel, 2⅜ inches in diameter. These conditions result in a fixed extension of the specimen of 18.75%. The subjective rating system referred to above is used.

Formulations and Curing Conditions

The base recipes and curing conditions used follow.

TABLE 1. FORMULATIONS AND CURING CONDITIONS

	Natural Rubber	SBR
Smoked sheet	100.0	——
SBR 1500	——	100.0
HAF carbon black	50.0	50.0
Zinc oxide	5.0	4.0
Stearic acid	3.0	2.0
Petroleum softener	3.0	10.0
N-cyclohexyl-2-benzothiazole sulfenamide*	0.5	1.2
Sulfur	2.5	1.75
Additive	—1.5 parts except where indicated—	
Cure	45'/292° F.	60'/292° F.

* Santocure (Monsanto Chemical Co., Rubber Chemicals Department).

Experimental Results

Factors Involved in Observed Creep

It was of interest, in the early stages of this work, to determine whether oxidative attack (as opposed to attack by ozone) plays an important part in the creep of the thin ring specimens upon exposure to the atmosphere within the time scale of the experiment. Accordingly, six stocks were prepared in natural rubber and SBR bases, respectively. One of these was a blank control; two contained additives with firm commercial reputations as antioxidants; and three contained additives which have been repeatedly demonstrated in other tests in this laboratory to be effective antiozonants. In Figures 3 and 4 the X-designations refer to antioxidants, and the Z-designations refer to additives found to be antiozonants in other tests.

In both natural rubber and SBR, X-1 is shown to promote faster creep than is observed in the blank although it is an effective antioxidant. The same effect has been observed in other methods for measuring ozone resistance. The antioxidant, X-2, offers no apparent protection in natural rubber against creep and a moderate amount of protection in SBR. Other ozone resistance tests indicate that X-2 is measurably effective in both natural rubber and SBR, but much poorer than Z-1, Z-2, or Z-3. It was concluded from these results that the creep which occurs in 1-4 weeks of exposure is, from practical considerations, almost entirely due to loss of supportive cross-sectional area resulting from ozone cracking.

Correlation with Other Tests

In Figure 5 is a series of ozone-creep curves representing six antiozonants as additives in the SBR tread formulation shown earlier. The additives were studied also in the indoor dynamic test, the outdoor intermittent static-dynamic test, and the outdoor static test. The additives were employed at concentrations of 1.5 parts per 100 of SBR in all tests. Figure 6 shows the ratings, in order of effectiveness, of these antiozonants as determined through the four individual test procedures.

There is excellent agreement among the four tests as to the recognition of the best and worst stocks. The ratings derived from the creep test correlate most closely with those of the indoor dynamic test. The correlations between creep and the other two tests are reasonably good.

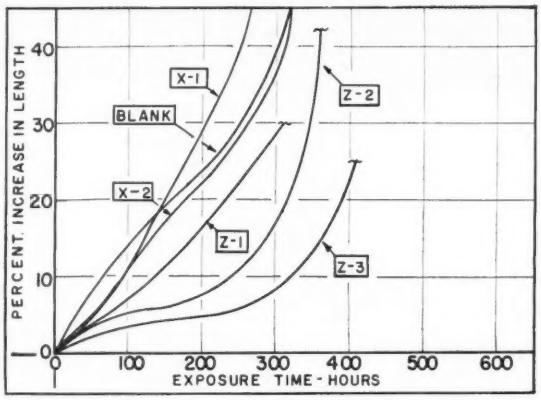


Fig. 3. Antioxidants and antiozonants in natural rubber tread stock

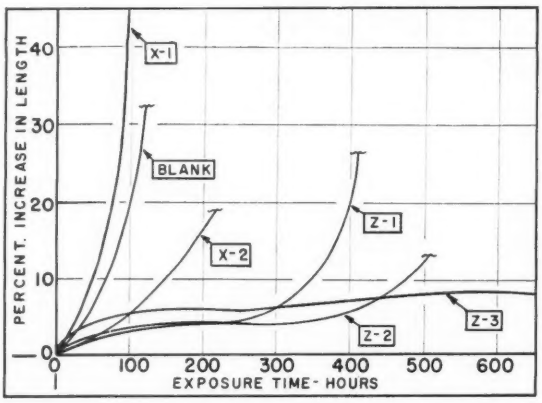


Fig. 4. Antioxidants and antiozonants in styrene-butadiene rubber (SBR) tread stock

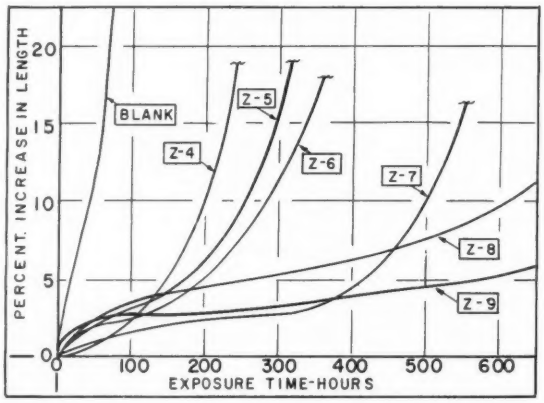


Fig. 5. Exploratory antiozonants in SBR tread stock

Effectiveness of Wax

Waxes are relatively inert toward ozone, and films of wax are effective physical barriers to ozone attack. These additives to the rubber system depend upon their ability to bloom out on the surface of the vulcanizate.

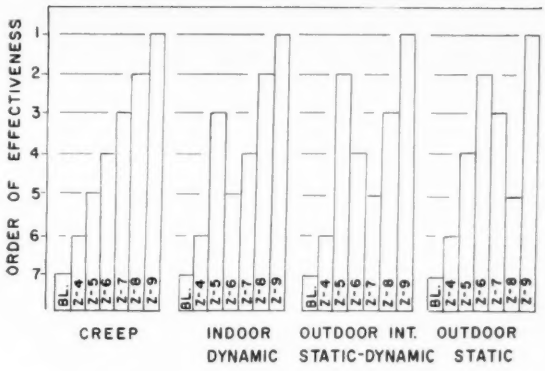


Fig. 6. Order of antiozonant effectiveness in SBR tread stock in various tests

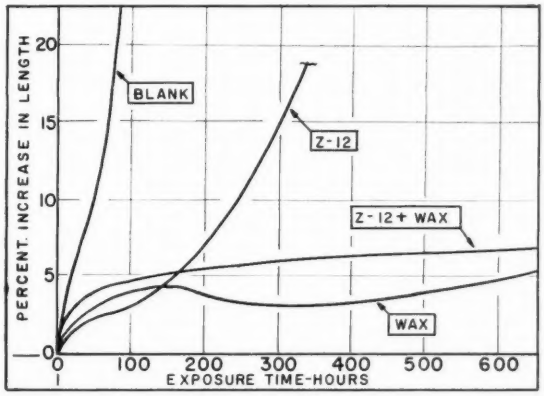


Fig. 7. Wax as antiozonant in SBR tread stock

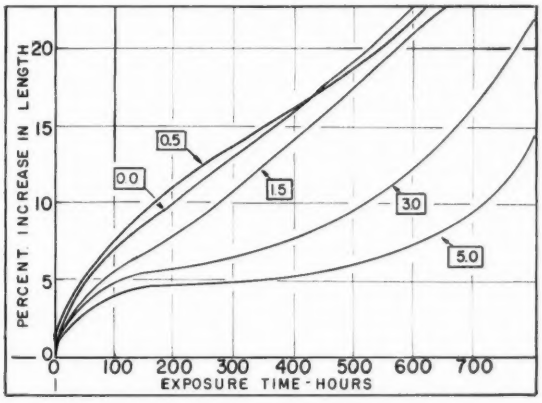


Fig. 8. Antiozonant Z-10 in natural rubber tread stock

As long the film remains unbroken, it functions properly. In a rubber product which is flexed in service the presence of wax is usually a liability. Powell and Gough (2) reported that the use of protective films on products which are flexed in service leads to fewer and deeper cracks.

Wax is occasionally tested as an additive in this laboratory in the indoor dynamic test referred to earlier. The samples containing wax crack more severely than the blank controls, particularly so when the stock is of natural rubber base. In agreement with the reference cited above, there are produced fewer and deeper cracks and a more severely deteriorated specimen when the latter contains wax.

In view of the foregoing, it was of interest to determine whether a waxy additive would maintain film continuity on the surface of the creep specimen, or whether creep would tend to perpetuate itself by causing continuing disruption of the wax film. Figure 7 shows the effects of the use of 1.5 parts of a proprietary wax marketed as an antiozone cracking additive. The wax provided excellent protection against cracking. Film continuity of the wax was apparently maintained by continuous blooming to the rubber surface and/or by repair of cracks through softening and flow of the exposed wax.

The market effectiveness of a physical protectant of the type represented by wax places the ozone creep test in the category of static tests. The degree of correlation between the ozone creep test and three other types of tests, as described earlier, would suffer if wax were included as an additive. However, correlation between static and dynamic ozone cracking tests is generally poor with regard to waxy additives as opposed to chemical protectants. The six additives employed in the correlation study were all of the chemical type.

Concentration of Antiozonant

Figures 8 and 9 represent concentration studies of an antiozonant (Z-10) in natural rubber and SBR tread stocks, respectively. Antioxidants generally show a maximum in effectiveness at concentrations below five parts per hundred of elastomer, but this behavior does not seem to be characteristic of antiozonants.

It is noted from Figure 8 that in natural rubber 1.5 parts of antiozonant Z-10 offers a small positive degree of protection, but to obtain a substantial degree of protection 3-5 parts are required. The SBR stock which contained no antiozonant cracks more severely and fails sooner than the corresponding natural rubber stock. However, SBR is more easily protected than is natural rubber, by the type of antiozonant used. Even 0.5-part provides appreciable protection. Use of higher concentrations reduces ozone cracking markedly. The time scale of the experiment is too short to show fully the advantage which may exist through use of 5.0 parts.

Time of Cure

Two SBR tread stocks, one containing no added antiozonant and the other containing 1.5 parts of antiozonant Z-11, were cured for various lengths of time at 144° C. Ozone creep data for these stocks are shown in Figure 10. The 30- and 120-minute cures represent undercures and overcures, respectively. The 45- and 60-minute cures are in the optimum range. In the stocks containing no additive there is no definite trend in the results, while in the additive-containing stocks the undercure shows more rapid cracking. The optimum and overcures do not differ much in resistance to ozone cracking.

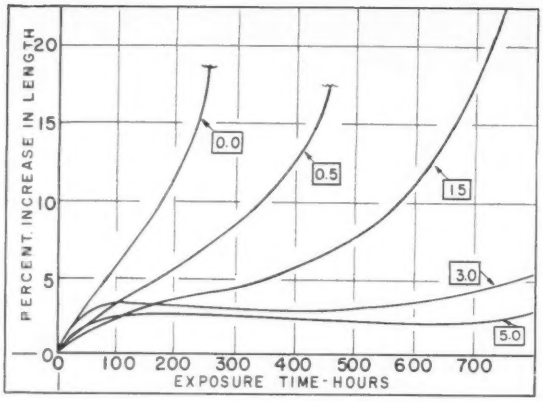


Fig. 9. Antiozonant Z-10 in SBR tread stock

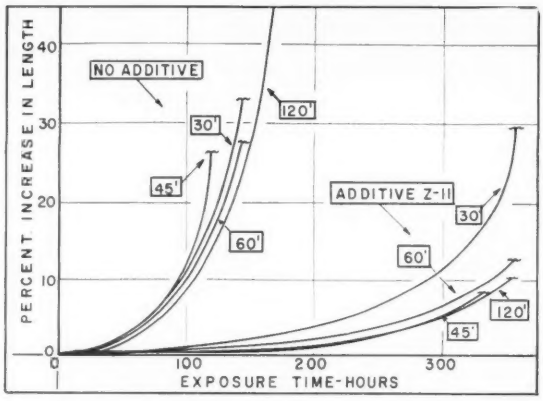


Fig. 10. Ozone crack vs. time of cure at 144° C. with SBR tread stock

Discussion of Results

The advantage of the creep method of assessing severity of ozone attack resides not only in freedom from subjectivity of measurement, but in the high degree of resolving power which is obtained. Differences between stocks in ability to resist ozone attack are emphasized because the faster a vulcanizate loses supportive cross-sectional area through the process of ozone cracking, the greater is the resulting specific stress on the reduced cross-section. Higher stress on the uncracked surface is conducive to more rapid formation of new cracks, and higher stresses at the apexes of those cracks already formed leads to more rapid growth of the cracks. Thus a poorer stock is penalized, and a better stock is rewarded.

On the other hand, in tests which employ a constant degree of distortion in the sample, the opposite condition is encountered. Crack formation and crack growth tend to be self-regulating owing to relaxation of stresses in areas neighboring the cracks and at the apexes of the cracks formed. In this type of test, preponderant in this field, the better stock is penalized, and the poorer stock is rewarded.

Existence of "critical strain" in the ozone cracking of rubber has been described as that degree of elongation, maintained during exposure, at which the "severity" of cracking passes through a marked maximum (1). This phenomenon is related to the observation that the number of cracks formed per unit area increases with the degree of strain prevailing during exposure. The often-referred-to "critical strain" owes its existence to competition between crack formation and crack growth in a rubber sample which is exposed at constant strain. Critical strain, for this reason, varies with the type of stock, state of cure, ambient ozone concentration, and a number of other factors. It is not surprising, then, that critical strains of as low as 3% (10) and as high as 50% (11) have been reported.

In the type of test described here, employing constant load rather than constant elongation during exposure, competition between crack initiation and propagation is minimized, and critical strain is a factor of much less importance than in tests where a fixed degree of distortion is maintained.

Summary and Conclusions

An ozone resistance test has been designed that allows continuous, objective, and non-destructive measurement of the extent of ozone cracking in vulcanized elastomers. The test involves measuring continuous creep of ring specimens cut from flat vulcanized sheets, 0.025-0.030-inch thick. There is suspended from the ring a dead load of sufficient mass to produce an initial extension of 20%. Because of the high ratio of surface to volume of the specimen, the loss of supportive cross-sectional area accompanying ozone cracking results in appreciable lengthening of the loaded ring.

Data presented represent outdoor exposure of tire tread vulcanizates containing exploratory antiozonants. Duration of the test in warm weather varies from one week for poorer antiozonant-additives to 1-2 months for more effective additives.

It is demonstrated that the observed creep, within the time scale of the experiment, is attributable almost entirely to ozone cracking as opposed to oxidative deterioration. Reasonably good correlation with other ozone resistance tests was found. Effectiveness of wax as an additive is shown. The variables, state of cure, and antiozonant concentration are reported.

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Semimicro Rapid Reflux Method for Solvent Extraction of Rubber Products

By K. E. KRESS

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An unusually rapid, but precise semimicro procedure for solvent extraction of rubber products is presented and is proposed as a replacement for the conventional procedure of the American Society for Testing Materials, wherever possible.

The speed, increased extraction capacity provided in a given laboratory, and solvent economy offered by this rapid reflux method make solvent extraction a more promising tool than heretofore for the control of quality in the manufacture of rubber goods.

SOLVENT extraction with acetone, using the standard American Society for Testing Materials siphon cup[1] and the conventional Soxhlet apparatus, has been standard practice in the rubber industry for more than two decades. Need of such special expensive apparatus could be eliminated, and consistency of extraction temperature as well as rate of extraction is assured, if the sample itself is weighed before and after reflux extraction by direct immersion into the boiling solvent. Memmler[2] suggested this possibility, but considered the extracted material to be so susceptible to oxidation that drying was carried out in the dark in vacuum at room temperature, or else in a stream of nitrogen at the lowest possible temperature.

Where solvent extraction is concerned, the modern rubber laboratory is chiefly interested in analysis of cured and highly compounded rubber products, many of which are made of the new synthetic rubbers that are much less susceptible to oxidation than natural rubber. The standard extraction procedure for styrene-butadiene rubber (SBR) calls for a two-hour reflux extraction of the sample placed directly in ethanol-toluene azeotrope (ETA) and then oven drying in air for two hours at 105° C. prior to weighing.[3]

With the increasing complexity of today's "tailor made" rubber compounds, it is difficult to draw any positive conclusions relating type or quantity of compounds in the stock to the % ASTM acetone extract as such. It appears that any solvent could be used for extraction purposes as long as a solvent extract figure is obtained that is reproducible and independent of normal variables of analysis such as sample weight, solvent volume, solvent temperature, and time to complete extraction to a constant level.

Need of a thorough investigation was apparent, because the ASTM procedure has been standard for so long that the burden of proof on any new technique is heavy. The following procedure is essentially the same as that used throughout the experimental investigation.

[1] "ASTM Standards, Part 6-Rubber, (D297-55T) Chemical Analysis of Rubber Products," p. 959. American Society for Testing Materials, 1916 Race St., Philadelphia, Pa. (1955).

[2] D. K. Memmler, "The Science of Rubber," translation by R. F. Dunbrook and V. N. Morris. Reinhold Publishing Co., New York, N. Y. (1934).

[3] "Specifications for Government Synthetic Rubbers," Section C-3. Federal Facilities Corp., Office of Synthetic Rubber, Washington, D. C. (Oct., 1952).

The Author

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He is a senior microchemist at Firestone, and his work deals mostly with the development of analytical control methods. He has published several papers dealing with the analysis of rubber products prior to this one.

Mr. Kress is a member of the American Chemical Society and its Rubber Chemistry and Analytical Chemistry divisions, and of the Akron Rubber Group.

Procedure for Cured Rubber Products

Prepare a sufficient quantity of the solvent by mixing 75% by volume commercial grade methyl ethyl ketone and 25% by volume denatured (2B) ethanol. Add about 20 ml. of this solvent to a 250 ml. Erlenmeyer flask for each sample to be analyzed. Heat the solvent to boiling under a suitable reflux condenser while the sample is being prepared.

Mill the compounded cured stock on a two-roll mill until homogenous; then sheet out one gram or less with the mill set as tight as possible. Make several passes with a single unfolded sheet until the sample is as coherent as possible. (See alternate sample preparation below for samples that cannot be milled into a coherent sheet.) With scissors, cut 80 to 110 mg. samples into different shapes to make identification possible. It is convenient to cut samples in the form of squares, triangles, circles, diamonds, and rectangles of different lengths. Weigh carefully to 0.1-mg. on a suitable balance.

Drop the weighed samples into the boiling solvent and continue rapid boiling for 30 minutes. Remove the flask from the hot plate, and pour contents through a fine wire screen, discarding the solvent. Press the samples between folds of absorbent paper towels to remove excess solvent; then dry samples in oven for 15 minutes at 110° C. Remove and allow to cool for 5 to 10 minutes before weighing to 0.1 mg. Per cent loss in weight is % solvent extract, qualified according to solvent used.

$$\% \text{ solvent extract} = \frac{\text{loss in weight on extraction} \times 100}{\text{original sample weight}}$$

The table below indicates the designation of the extract when various solvents are used with the rapid reflux method.

Type Solvent Used for RR Method	Designation of Extract
Mixture of 75% MEK and 25% 2B ethanol by volume	"% ASTM acetone equivalent extract"
Acetone alone	"% free extract"
MEK alone	"% total extract"

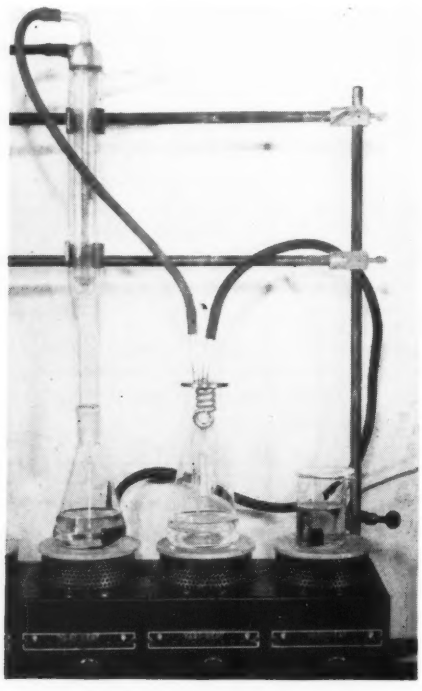


Fig. 1. Apparatus for solvent extractions. Left to right: (1) Rapid reflux apparatus for non-azeotropic solvents. (2) Standard ASTM apparatus. (3) Beaker with watch glass, illustrating extreme simplicity possible with single or azeotropic solvents. Black square in beaker is typical sample

Apparatus

A Hopkins reflux condenser with a ground glass necked 250 ml. Erlenmeyer has been used, but a flask fitted to a condenser with a cork or rubber stopper would serve as well. Condensers are necessary as the 75/25 solvent mixture is not azeotropic.

Alternately, with azeotropic or single solvents, the extract can be determined in any-type open flask without a water cooled condenser if more solvent is used, or the solvent evaporated is replaced as needed during the ½-hour refluxing. (See Figure 1.) This means no special apparatus is required for any solvent mentioned in this paper except the 75/25 or similar MEK/ethanol mixtures.

Alternate Sample Preparation

Occasionally the sample cannot be milled into a coherent sheet. In such a case two alternate procedures are possible: extraction of the sample, as is, (adapted to porous foam rubber or a very thin slice of white sidewall), or placing the milled crumbs into a filter paper envelope for extraction. Tacky uncured stocks may be sandwiched between paper or wired to a glass rod or metal tube to prevent cohesion during extraction. This procedure, however, was designed for cured compounded stock and is not recommended for uncured or reclaim rubber, without special care, including change of solvent to acetone alone.

Sample Weight

If samples larger than 100 mg. are used, the solvent volume should be increased at a rate of about 20 ml. per 100 mg. of sample.

Extraction on a micro-scale with 5 to 10 mg. samples is practical with a micro Roller-Smith precision balance (or similar balance) weighing to 0.01-mg.

Experimental Details

Time for Extraction

The data of Figure 2 makes it apparent that there is considerable variation in recoveries with different solvents. Surprisingly enough, however, solvents giving recovery close to the ASTM acetone data of 11.4%

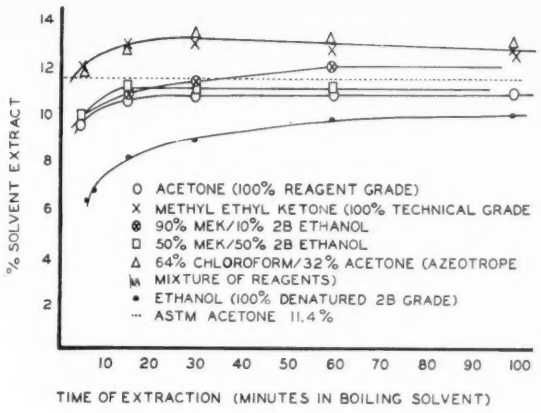

% SOLVENT EXTRACT
TIME OF EXTRACTION (MINUTES IN BOILING SOLVENT)
O ACETONE (100% REAGENT GRADE)
X METHYL ETHYL KETONE (100% TECHNICAL GRADE
90% MEK/10% 2B ETHANOL
50% MEK/50% 2B ETHANOL
64% CHLOROFORM/32% ACETONE (AZEOTROPE
MIXTURE OF REAGENTS)
ETHANOL (100% DENATURED 2B GRADE)
ASTM ACETONE 11.4%

Fig. 2. Rapid reflux extraction results with different solvents for tire tread stock

for this tire stock, did so with only 15 minutes refluxing.

Continuation of the refluxing from 30 minutes up to 100 minutes did not significantly increase recoveries with any solvent except ethanol, which is obviously a poor solvent for the purpose in mind. Note that % extract at different times represents different weighed samples and was not obtained by re-extracting a single sample for different times.

This asymptotic recovery, showing essentially complete extraction with only 15 to 30 minutes' refluxing, has been repeatedly verified on a variety of compounded stocks. A decrease in extraction time from the ASTM 16 to 20 hours to rapid reflux (RR) time of 30 minutes is a tremendous change. Possibilities for a very rapid extraction procedure were evident if the right solvent was available.

Comparison with ASTM

Extraction data using a mixture of 75% MEK and 25% 2B ethanol, and other solvents, are illustrated in Figure 3. These are routine extraction data obtained in analysis of the white sidewall, tread, and body ply stocks of several passenger tires. It is evident that the 75/25 solvent by RR without exception gives results in close agreement with the ASTM acetone extract data. This is clear because the points marking the 75/25 solvent recovery consistently fall closer to the line of equivalence than data for any other solvent. (This "line of equivalence" is a line drawn through points where ASTM data would agree exactly with RR data.)

It is clear in the data of Figure 2 and 3 that MEK gives an RR extract consistently about 0.5 to 1.5% higher than that of ASTM acetone extract. It has been found that MEK alone recovers what may be considered the total extract. The data of Figure 4 shows that average MEK recovery is within about 0.5% of the sum of ASTM acetone and chloroform extracts. These data were obtained by several different analysts on a wide variety of compounded cured stocks.

Azeotropic chloroform-acetone solvent recommended by ASTM as a solvent for total extract will give recoveries comparable to that of MEK alone by RR method (Figure 2). The azeotrope would be preferred to MEK for ASTM extraction because its low boiling point facilitates drying of the extract. No such consideration need be made, however, with the RR method where the trace of MEK on the sample is rapidly evaporated at 110° C.

The factor which makes MEK preferable to chloroform/acetone azeotrope, or to chloroform alone, is the excessive swelling of rubber stocks in the latter solvents. This swelling is undesirable as it softens the rubber and may cause some of the sample to flake off, yielding erroneously high % extract values. The reduced amount of swelling in MEK causes no trouble.

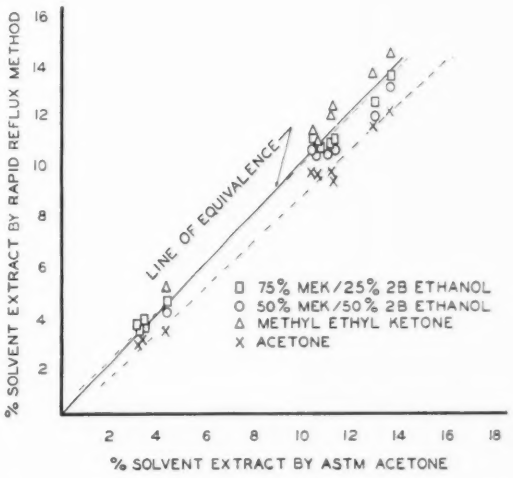

% SOLVENT EXTRACT BY RAPID REFLUX METHOD
% SOLVENT EXTRACT BY ASTM ACETONE
LINE OF EQUIVALENCE
75% MEK/25% 2B ETHANOL
50% MEK/50% 2B ETHANOL
METHYL ETHYL KETONE
ACETONE

Fig. 3. Comparison of extraction data using rapid reflux method and ASTM method for white sidewalls, tread and carcass samples from several tires

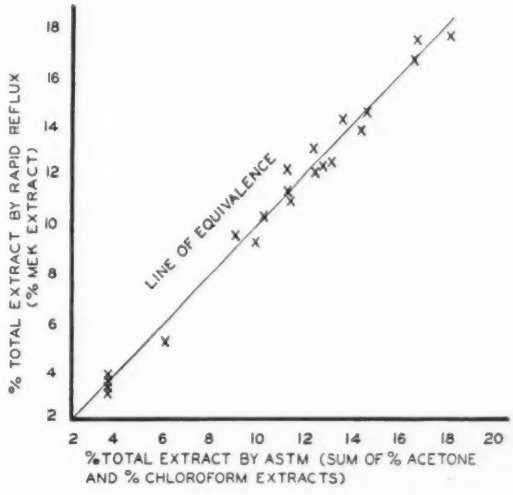

% TOTAL EXTRACT BY RAPID REFLUX (% MEK EXTRACT)
LINE OF EQUIVALENCE
%TOTAL EXTRACT BY ASTM (SUM OF % ACETONE AND % CHLOROFORM EXTRACTS)

Fig. 4. Comparison of total extract, rapid reflux method with methyl ethyl ketone vs. ASTM % acetone plus % chloroform, for samples of tire tread, sidewall, and body stock

This small amount of swelling and the higher boiling point of MEK probably account for the superiority of MEK over acetone as a solvent for total RR extract determination. On the other hand, where the extract itself is to be analyzed, as for wax determination, the low-boiling azeotropic solvent may be used if desired.

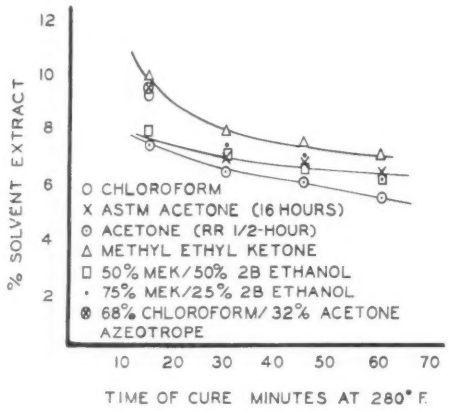


Fig. 5. Effect of cure on solvent extract recovery

Partially Cured and Uncured Stocks

This RR extraction procedure is recommended for compounded stocks at or near the optimum cure found in finished commercial rubber products. The RR procedure with 75/25 solvent, however, will be applicable to partially cured compounded stocks as well. The data of Figure 5 make it clear that, at a degree of vulcanization above about half that of optimum cure, (i.e., above 30 minutes at 280° F. in this case) the 75/25 solvent extract will agree well with regular ASTM acetone results. Also, the higher MEK total extract will parallel ASTM data. It is probable that all stocks which appear to be cured by visual inspection will be at a degree of cure satisfactory for direct RR extraction with the 75/25 solvent or MEK alone.

On the other hand, for low cure, and for uncured stocks, the solvent for RR should be changed. In Figure 5, the convergence of RR extract data with acetone alone and the ASTM acetone data at 15 minutes cure is noted. This fact indicates that acetone alone would serve as a suitable solvent for RR extraction of unvulcanized or low-cure compounded stocks and is emphasized by the divergence and high total extract with MEK alone at 15 minutes' cure. Obviously MEK, like chloroform and chloroform/acetone azeotrope, will solubilize uncured rubber. MEK alone should not be used with uncured stock. The same limitation is placed on use of chloroform or azeotrope solvent by the ASTM method.

Uncompounded Polymer

The data of Table 1 indicate that even uncompounded natural rubber may be extracted by this method in ½-hour to give the same results as a 20-hour ASTM acetone extract if the proper solvent is used. Here acetone alone will probably prove satisfactory. For most practical purposes of classification, a difference of a few tenths of 1% in extract is immaterial, or may be disregarded, considering the ease of obtaining these data by the RR method.

The sample of uncompounded rubber is preferably cut in the shape of a square or a circle to reduce the tendency of longer samples to overlap and adhere together, once out of the solvent. The samples are best removed individually from the solvent with tweezers; then are pressed lightly between folds of a compact paper towel to remove excess solvent. It is sufficient to dry the sample for 15 minutes at 110° C., but drying for as long as 45 minutes caused no weighable increase in weight for the samples of Table 1 (less than 0.1-mg., if any).

TABLE 1. RAPID REFLUX EXTRACTION OF CRUDE NATURAL CREPE RUBBER

Solvent for RR Extraction	% Extract	Average %	± % Mean Deviation	% Recovery of ASTM Acetone
Acetone				
(ASTM/ 20 hrs.)	1.83	1.86	0.03	....
	1.89			
(RR/0.5-hr.)	1.83			
	1.80	1.82	0.05	98
	1.74			
	1.92			
Denatured 2B Ethyl alcohol	1.91	1.95	0.04	105
	1.99			
Mixed Solvent (by Volume)				
% MEK/% 2B ethanol				
25/75	2.04			
	1.99	2.04	0.04	110
	2.10			
50/50	2.40	2.44	0.04	131
	2.48			
75/25	2.84			
	2.86	2.85	0.01	153

All data above, except ASTM acetone extract, were obtained by rapid reflux extraction for 30 to 45 minutes with drying for 15 minutes at 110° C. in circulating air oven. Sample size, 80 to 110 mg.

The ETA reflux extraction of homogenous SBR could be done advantageously on a semimicro scale. A mixed MEK and ethanol solvent would probably serve as well as the ETA solvent used.

Solubility of Compounding Materials

Polymers

Insolubility of the polymer is essential and has prohibited the use of MEK alone for uncured and uncompounded stock extraction. The solubility of neoprene in MEK and the 75/25 solvent tends to give high recoveries with part neoprene stocks (see Table 4), and use of a different solvent is recommended for any mixed polymer stock containing neoprene. Acetone alone or mixtures of acetone and ethanol may prove a satisfactory solvent. Cured stocks in which the polymer is all neoprene can be reflux extracted with the regular solvents, including MEK.

Reclaim and Mineral Rubber

It is a general practice today to attribute abnormally high ASTM chloroform extract following acetone to two things: high reclaim content, or presence of asphaltic tars or bitumens such as mineral rubber. Work with RR extract has here indicated both these conclusions may often be fallacious with properly cured complex tire stocks of today.

Analytical data for a series of cured compounded stocks with reclaim content ranging from 0 to 60% showed a difference between ASTM acetone equivalent extract and the total extract (which corresponds to ASTM chloroform extract) ranging from 1.4 to 1.7%. This is an increase of only 0.3% chloroform extract and can hardly be considered a significant measure of reclaim content.

TABLE 2. SOLVENT EXTRACTION OF MINERAL RUBBER FROM NATURAL RUBBER CURED COMPOUNDED BODY STOCK FORMULA

	1.6% Mineral Rubber Standard		5.0% Mineral Rubber Standard	
Solvent	Av. % RR Extract	% ASTM Extract	Av. % RR Extract	% ASTM Extract
Acetone	8.3	8.72	10.2	9.82
Chloroform	....	0.65	....	1.13
MEK/2B ethanol (75/25)	9.6		11.2	
MEK alone	9.4		11.6	
Azeotrope (68/32:: chloroform/ acetone)	9.5		11.2	
	Total ASTM	9.37		10.95

ASTM regular procedure of 16 to 20 hours' acetone extraction followed by four hours' chloroform extraction. RR extraction for ½-hour.

Consideration of the data of Table 2 for extraction of mineral rubber from a cured compounded natural rubber stock formula indicates that chloroform extract is not an adequate measure of mineral rubber content when 5% or less is added to a stock. There is an increase of only 0.48% in ASTM chloroform extract for an increase from 1.6 to 5% mineral rubber content. Note the close agreement of MEK and azeotropic solvent data for total extract with the sum of ASTM acetone and chloroform data.

With this particular stock, the figure for the RR acetone extract agrees better with the ASTM acetone extract figure than it does with the data for RR with 75/25 solvent. This is an exception to the usual case and indicates an unusually high "free" acetone extract, even with added mineral rubber present. This emphasizes the fact that chloroform extract, or the difference between MEK and 75/25 solvent extracts, is not always a significant measure of mineral rubber content, as is generally believed.

It is theorized that at low concentrations the mineral rubber is first broken down or otherwise solubilized in the softener present in the compounded stock at mixing temperatures. Apparently this conditioning makes for easy extraction of much of the mineral rubber with acetone alone, even though the original mineral rubber is but slightly soluble in hot acetone.

Waxes, Soaps, and Tarry Softeners

It has been shown that presence of reclaim and mineral rubber does not always explain the significance of high (more than 1%) ASTM chloroform extracts following ASTM acetone extraction. The data of Table 3 are presented to show that a high chloroform extract (or its RR equivalent) may be traced to several compounding materials. It is noted that the difference between total MEK extract and 75/25 solvent extract is about 1% or higher for normal amounts of the following compounding materials added as the only extra component in a base compound: Para Flux[4] softener, petroleum waxes, and zinc stearate soap.

The base stock extracted here contained 66% SBR and 27% carbon black, with zinc oxide, accelerator, and sulfur in normal amounts. Note that almost identical results for MEK and 75/25 solvent extract of this base stock were obtained, with a difference of only 0.02%. It is apparent that materials other than these basic ingredients normally contribute to the ASTM chloroform extract following acetone extraction.

Note in the last column of Table 3 that % MEK minus % acetone recovery is proportional to, and about three times greater than, the recovery of % MEK minus % 75/25 extract. (Items underneath the line divided by items on top of the line.) It is apparent that this proportionality is reasonably reproducible, because % MEK minus % 75/25 data amounts to 30 to 35% of % MEK minus % acetone data for five out of seven stocks. (Items on top of line divided by those beneath the line times 100.) The higher value of the MEK extract is due to partial acetone insolubility by RR of some hard-to-dissolve compounding materials present which are much more soluble in the 75/25 solvent. In the case of the base stock, it could be soaps in the SBR polymer, which require ETA (ethanol-toluene azeotrope) solvent for complete extraction.

If the rubber chemist keeps the above point in mind, he may find that determination of "% free extract" by RR with acetone alone yields as satisfactory a value as ASTM acetone (or RR with 75/25 solvent) for control purposes.

Classification of Rapid Reflux Extracts

The solvent extraction data by ASTM methods are so well founded that many rubber chemists would hesitate to use the RR method if the solvent extract recovery was not comparable to that of conventional ASTM extraction. For this reason the solvents were first selected so that duplication of ASTM data could be obtained. It is emphasized, however, that almost any desired data can be obtained in a reproducible manner by choice of a suitable solvent. Below are listed illustrations of the relations between designated extracts and the manner by which they may be obtained with different solvents by ½-hour RR extraction and direct weighing of the sample.

[4] Saturated polymerized hydrocarbon (C. P. Hall Co.).

Sample	Solvent Extract Obtained (RR) or Calculated	Designation of Extract
Cured compounded stock	Acetone alone	"% free extract"
	MEK alone	"% total extract"
	Mixed 75%MEK/ 25% 2B Ethanol	"% ASTM acetone equivalent extract"
	2% Conc. HCl in MEK	"% acidic MEK extract"
Uncured compounded stock	Acetone alone	"% ASTM equivalent extract—uncured"
Uncompounded natural rubber polymer	Acetone alone	"% ASTM equivalent extract —uncompounded"
Calculated % Extract		
Cured compounded stock	(% total extract -% ASTM acetone equivalent)	"% ASTM chloroform equivalent extract"
	(% acidic MEK -% total extract)	"% acid soluble inorganic fillers"

The rubber chemist will normally be concerned with the % ASTM acetone equivalent extract (75/25 solvent) and % total extract (MEK). However, the versatility of the method should not be overlooked. Determination of acid soluble inorganic fillers in the manner noted can prove a rapid control test for zinc oxide, calcium carbonate, etc. Use of 2% aqueous acid would not be satisfactory with the average stock because the hot aqueous acid would partially extract retarders, accelerators, softeners, etc., as well as the acid soluble inorganic fillers. This difficulty is obviated by using acidic MEK and MEK alone on separate samples and subtracting results. Data have indicated that hydrochloric acid concentration between 1% and 5%, and extraction time are not critical for the acidic MEK solvent.

Advantages

The advantage of the RR method, in reducing both working and elapsed time, is obvious to the rubber chemist. Not so apparent is the advantage that no special extraction apparatus is required for determination of RR "free" and "total" extracts. Extraction by RR could be carried out at constant temperature of the boiling solvent in any container at any convenient hot-plate temperature.

Analysis on a micro scale with 5 to 10 mg. of sample has been proved practical by RR procedure. This offers a rapid method for checking spot dispersion of solvent soluble materials, which may aid in solution of compounding problems (see last column of Table 4).

As many as 10 different semimicro samples may be extracted simultaneously in 200 ml. of solvent in one flask. This procedure greatly increases the solvent extract capacity of a rubber laboratory. In combination with one of the new automatic balances, which make weighing faster than titration, the RR extract method offers an unusually rapid control procedure.

No special solvent purification is required, as for ASTM extraction, because any small amount of nonvolatile material present will not affect the RR results. The reduction of solvent volume from 75 ml. to 20 ml. per semimicro sample, or to only 5 ml. for micro samples, is an additional saving.

There are cases in rubber product analysis where a solvent extract is made prior to a regular analysis, and use of RR extraction can greatly reduce elapsed time for such procedures; for example, determination of rubber hydrocarbon on extracted stock after ½-hour RR with MEK instead of overnight azeotrope extraction. Faster analysis of the RR extract itself is possible where wax, oil, antioxidant, etc. are being determined.

Precision

The data of Table 4 are cited as illustrative of the excellent precision of which the semimicro method is capable. Agreement of duplicate RR analyses within 0.2% recommended for ASTM data[1] is to be expected. In case such agreement is lacking; it is a simple matter by RR to recheck the % extract in one hour elapsed time, where the results of an analysis would be postponed a day if it were necessary to check an ASTM extraction.

The application of the extract data should be the determining factor limiting the precision and accuracy required. If this important point is kept in mind, it will be found that frequently a duplicate analysis checking within 0.5% extract would be entirely satisfactory precision, particularly with today's high-extract synthetic stocks.

Accuracy

The absolute accuracy may be judged for total extract within a reasonable degree. This is not true, however, for ASTM acetone extract (or 75/25 solvent RR equivalent), which represents incomplete solution of solvent soluble materials. For total extract the data of Table 3 may be cited. The theoretical base stock extract was 6.2%, as calculated from the stock formula and known solubility of compounding materials. Known amounts of Para Flux, waxes and zinc stearate added to this base stock were quantitatively recovered by MEK, as % MEK recovery of theory ranged from 97 to 103% for five out of six stocks. This is excellent recovery of solvent soluble materials and proved conclusively that MEK is a suitable solvent for determination of total extract.

For the purpose of comparing results, Figures 3 and 4 were set up comparing RR data with ASTM extract data for the same stock. If it is assumed that ASTM results were always correct, then the vertical displacement of any point from the "line of equivalence" in the figures appears as an error in RR results. Actually, there are probably cases where ASTM results were not so precise as RR data, and the ASTM data are actually in error. Only one analysis was made for each ASTM extraction because of time and work involved, but RR results represent the average of two or more samples. This policy means that accuracy of duplica-

TABLE 3. EFFECT OF VARIOUS COMPOUNDING MATERIALS ON % SOLVENT EXTRACT WITH DIFFERENT SOLVENTS

Stock No.	Description of Stock	% Total Extract by Theory	Average RR % Solvent Extract			% Recovery (% MEK of Theory)	Ratio Extracts (% MEK — % 75/25) x 100 / (% MEK — % Acetone)
			Acetone	75/25	MEK		
1	Base stock (sidewall formula)	*6.2	4.86%	6.46%	6.44%	103%	—0.02%/1.6%
2	Base (#1) + 6.40% Para Flux softener	12.6	9.85	11.7	12.6	100	0.9/2.8 = 32%
3	Base (#1) + whole-tire reclaim	....	5.46	7.36	7.9	....	0.5/2.5 = 20%
4	Base (#1) + 5.9% Para Flux + 1.5% reclaim extract	†13.6	10.4	12.2	13.4	98	1.2/3.0 = 40%
5	Stock #4 + 2.9% paraffin wax	16.5	13.4	15.2	16.0	97	0.8/2.6 = 31%
6	Stock #4 + 2.9% microcrystalline wax	16.5	13.8	15.6	16.6	101	1.0/2.8 = 35%
7	Base (#1) + 3.3% zinc stearate	9.5	5.25	8.6	10.2	107	1.6/5.0 = 32%
8	Base (#1) + 5.8% factice	....	5.5	7.6	8.2	....	0.8/2.7 = 30%

* %Theoretical extract calculated from SBR base stock compounding formula. Assume Para Flux, paraffin wax, microcrystalline wax, and zinc stearate are completely soluble in calculating theoretical extract. Factice is not all soluble in above solvents, but it might be extracted by the same RR technique with alcoholic potassium hydroxide if the alkali salt is washed from the sample prior to drying and weighing.

† Corrected for solvent extract equivalent to 7.9% — 6.4% = 1.5% MEK extract owing to reclaim added in stock #3. This particular whole-tire reclaim must have contained a low extract.

TABLE 4. COMPARISON OF ASTM ACETONE AND RR 75 25 SOLVENT EXTRACTION

Type Stock	Type Polymer	% ASTM Acetone	Av. % RR 75/25 (Semimicro)	(% RR- % ASTM)	% Recovery (RR x 100/ASTM)	Av. % RR 75/25 (Micro)
Stocks Where RR Found Satisfactory: (All Cured Compounded Rubber Products)						
Tube (a)	Butyl	11.9	12.50	0.6	105	(Sample
(b)	Butyl	15.2	15.00	—0.2	99	5 to 10 mg.)
(c)	Butyl	14.3	14.02	—0.26	98	14.0
			14.05			
			Av. 14.04			
(d)	Butyl	14.85	14.90	0.0	100	14.9
			14.81			
			Av. 14.85			
Passenger Tire						
Tread	Natural	6.67	6.77	0.1	101	6.4
Sidewall	Natural	7.48	7.38	—0.09	99	7.0
Inner liner	Natural + SBR	8.99	9.01	0.02	101	8.8
Body plies	Natural	9.98	10.1	0.13	101	10.2
Tractor tread	Natural	6.21	6.31	0.11	102	
			6.32			
Black sidewall		14.95	15.32	0.4	102	
		15.01	15.45			
		Av. 14.98	15.38			
Bicycle tread (a)		17.7	17.7, 17.9	0.1	101	
(b)		14.0	14.3, 14.7	0.5	103	
Mechanical goods	Nitrile	15.2	15.6, 15.6	0.4	102	
Tire chafer	Neoprene (a)	35.4	34.5	—0.9	98	
	alone (b)	37.5	37.7	0.2	100	
Stocks Where RR Used with Reservations: (Need of Different Solvent Indicated)						
White sidewall (cured)	30% Natural with neoprene	1.53	2.08			
		1.42	2.18			
		Av. 1.48	2.13	0.65	144	
Buffing rib (cured)	30% Natural with neoprene	6.8	8.41	1.61	123	
Compound tube (uncured)	Butyl	5.14	7.53, 6.13	1.7	133	
Whole-tire reclaim* (uncured)	Mixed natural and SBR	17.1	19.4, 19.0	2.1	112	

* Acetone alone by RR for ½-hour yielded 17.4, 17.2% extract, which is in close agreement with ASTM 20-hour acetone extract (17.1%).

tion of ASTM acetone results by the RR method with the 72/25 solvent mixture is even better than the data reported here indicate.

The excellent relative accuracy of the RR extract method is illustrated by the data of Table 4. On a routine basis with a wide variety of cured compounded stocks the 75/25 solvent recovery has consistently been within 100% ±5% of the ASTM acetone extract.

Discussion of Results

Obsolescence of ASTM Method

The original reasons for the use of acetone as the organic solvent for the extraction of rubber and weighing of the extract were due to the following factors:

(1) Relatively high solubility of most compounding materials in acetone.
(2) Relative insolubility of natural rubber in this polar solvent.
(3) Low boiling point, enabling easy drying of extract.
(4) Tangible increase in accuracy obtained by direct weighing of extract rather than indirect weighing of stock, particularly where low-extract (1% to 3%) natural rubber polymers were concerned.
(5) Assumption that extract will be analyzed further, as for free sulfur, etc., on a routine basis.
(6) Accepted inability to oven dry uncompounded natural rubber so that it could be weighed without change in weight due to oxidation, or inconvenience of drying in inert atmosphere.

The solvent extract itself is not now commonly analyzed for total sulfur content to determine free sulfur of the stock, as much faster methods are available.[5] In special cases where the extract may be analyzed for wax, fatty acid, etc., the rapid reflux method may be used to advantage on larger samples to recover quantitatively the material sought using low boiling chloroform/acetone azeotrope, or any other suitable solvent.

Present-day compounding practices with natural rubbers normally give a solvent extract above 5%. In the case of the widely used SBR and butyl synthetics, the solvent extractable matter runs to 10-20% and higher. The accuracy obtainable by indirect weight of the extracted sample has been proved by actual analysis to be entirely satisfactory when solvent soluble material is at this level.

With the cured compounded stock and the short drying time required to remove traces of solvent from the sample, there is no problem whatever of air oxidation in the oven significantly changing the sample weight. Drying time of more than an hour at 110° C. will not significantly alter the sample weight of cured extracted stocks, and here only 10 to 15 minutes' drying is needed. In fact, considering the complex nature of solvent extracts, it appears that any problem of oxidation changing results would be more acute with weighed solvent extract. Thus, free sulfur might be lost; certain antioxidants might sublime or oxidize; low boiling fractions of softeners might be volatilized, etc. Caution in evaporating solvent extracts by the ASTM method has been emphasized in the literature.[1, 6]

Chloroform extract has long been considered a measure of asphaltic mineral rubber or "bitumens" in rubber compounds. This may be the case in high-bitumen mechanical goods stocks, but data reported here have made this point of questionable value for use in interpreting composition of chloroform extract for present-day tire, tube, and mechanical goods stocks. The chloroform which follows ASTM acetone extract merely dissolves residual materials only partially soluble in acetone; so it is itself of an indeterminate composition. It appears likely that this chloroform extract is a mixture of oxidized or partially cured rubber (and polyisobutylene when present), metallic salts of materials such as fatty acids (soaps) and accelerators, as well as certain softener fractions. For this reason the chloroform extract data are of questionable value for analysis of the present-day normal sulfur rubber product. Chloroform extract cannot continue any longer to be considered as representative of mineral rubber in a tire or tube stock where mineral rubber is now seldom used, but where chloroform extract runs nevertheless as high as 2%.

Acceptability of RR Method of Extraction

This rapid reflux method has proved so reliable and versatile that it is here proposed as a replacement for conventional ASTM procedure wherever possible. The ASTM method is then to be considered an alternate referee method to be used only when necessary. Likewise, it is proposed that RR with acetone alone (% free extract) and MEK alone (% total extract) be considered on their own merits for normal sulfur stocks rather than use of the 75/25 solvent mixture, which duplicates present ASTM acetone extract data. Reasons why this proposal is made are discussed below.

It has been proved that a solvent mixture of 75% MEK and 25% 2B ethanol will extract the same amount of material in ½-hour or less by RR that is extracted by ASTM acetone in about 20 hours. It is not so easy to prove exactly the same materials are extracted in comparable amounts, though this seems probable, because the most soluble materials will be extracted preferentially with either solvent. The mixed solvent apparently gives the same balance of good solubility due to MEK and partial insolubility due to ethanol that is achieved by acetone as a single solvent.

It appears that acetone by ASTM extraction acts to dissolve the readily soluble materials in one or two hours, after which a partial solution or fractionation of less soluble materials results on long extraction. Data illustrating this point are the ASTM acetone solubility of a commercial hydrocarbon wax mixture used in rubber compounding. The melting point of soluble fractions rose from 56° C. for two hours' extraction to 59° C. for two to six hours, with an insoluble residue melting point of 78° C.

The thought is proposed that the ideal solvents to use for extraction of rubber products will fall into one of two classifications. One group contains solvents that

[5] E. W. Oldham, L. M. Baker, M. W. Craytor, *Ind. Eng. Chem., Anal. Ed.*, 8, 41 (1936).
[6] J. Rehner, J. Holochak, *Ibid.*, 16, 98 (1944).

result in simple solution of very soluble "free" materials such as mineral oil, accelerators and antioxidants, without undue fractionation of hard-to-dissolve waxes, tars, soaps, etc. Acetone extract by ½-hour RR would fall in this class, though this is not true if used for 20-hour ASTM extraction. The other group of solvents are those giving total extract through complete solution of solvent soluble materials, such as MEK and chloroform/acetone azeotrope. It is thought that quantitative extract data would be found more informative if conditions were such that easily extracted or "free extract" materials were determined independent of "total extract." Consequently it is proposed here that rubber chemists think in new terms of "free" and "total" extract by RR rather than acetone and chloroform extract by present ASTM methods.

Rubber compounding is becoming a more specialized practice every day. Stocks are "tailored" to meet specific end-uses. The number and the variety of solvent soluble materials going into a stock is continually increasing. It seems only logical that methods of analysis, such as solvent extraction, should follow this pattern.

A specific method of extraction suitable for use with normal sulfur stocks should be considered on its own merit. A solvent extraction procedure that is set up so that it can be applied universally (in theory) to every cured or uncured rubber compound, as well as uncompounded rubber, places needless limits on rapid analysis by more specific methods. With the RR extraction method any solvent or solvent mixture that is suitable might be chosen for analysis of a specific type of material.

Summary and Conclusions

An unusually rapid, but precise semimicro procedure for solvent extractions of rubber products has been presented. The 100-mg. sample is weighed before and after extraction in a simple reversal of conventional macro methods, where the extract itself is weighed.

An investigation has proved that methyl ethyl ketone (MEK) will quantitatively extract all solvent soluble compounding materials in less than ½-hour by this reflux method. A mixed solvent of 75% MEK and 25% denatured alcohol will yield results in ½-hour that are identical, for all practical purposes, with a 16- to 24-hour acetone extract by ASTM procedure.

The speed, increased extraction capacity provided in a given laboratory, and solvent economy offered by this rapid reflux method make solvent extraction a more promising than heretofore tool for control of quality in the manufacture of rubber products. The RR method's proved practical application on an even smaller micro scale (5- to 10-mg. sample) offers all the advantages of any micro analysis.

Data have been presented to prove that precision and accuracy are comparable to conventional methods of solvent extraction.

Acknowledgment

The help of R. O. Lankenau and J. F. Witner in proving the method is appreciated. The aid of G. H. Wallace in securing special compounded stocks and in reviewing this report was most helpful.

The permission of the Firestone Tire & Rubber Co. to publish this work is gratefully acknowledged.

Rubber Industry Vulnerable

(*Continued from page 702*)

loans and grants to satellite municipalities for community facilities (schools, streets, water, sewers, etc.).

These are only a few of the recommendations of the Project East River Commission. It is to be doubted whether any administration will undertake the necessary expenditures to carry out such a program. On the other hand it is highly doubtful whether without such government assistance industry alone will effect the safer geographical patterns necessary to insure survival. Any expenses incurred by either the government or business should be looked upon as premiums on "atomic survival insurance." Should this insurance never be collected, it would still be worthwhile from the immense sociological benefits which would accrue to the nation from thinning-out concentrations.

Decentralization in the rubber industry should be harnessed and directed. The vulnerability of the industry was proved in the 1955 flood disasters in the northeastern sector of the nation. The suspension of rail and highway transportation took its toll in the rubber industry as well as other key industries.

The most extensive damage in the flood area occurred at the U. S. Rubber's Naugatuck, Conn., plant. Reclaim rubber production facilities were knocked out, and inventories of raw materials and finished goods were damaged. The footwear plant at Naugatuck suffered also: all payroll records were lost; many mills, Banbury mixers, and calenders were inactivated. Other affected plants were: U. S. Rubber's synthetic rubber plant in Naugatuck; its foam rubber plant in Woonsocket, R. I.; and its tire plant in Chicopee Falls, Mass. This flood damage is but a foretaste of what might happen in the event of a sudden enemy onslaught.

Summary and Conclusions

This is the pressing question: Is U. S. industry and the Federal Government disposing the national economy so that it has as few industrial eggs in one basket as possible? For the rubber industry, the answer is, so far, no.

One solution would be to work with the current decentralizing forces as suggested by the Project East River Report. In this way "scatter" can be introduced into American industry without the expenditure of exorbitant sums, without dislocation to existing metropolitan areas and industrial centers, and without undue violation of our free-enterprise system. Not only will these efforts tighten our nation's defenses, but the release from areas of industrial congestion will brighten the lives of many of our people.

EDITORIAL

Plant Dispersal—Atomic Age Survival Insurance

MORE attention should be paid to the geographical dispersal of future new plants constructed by the rubber and associated industries for many reasons, the foremost of which is survival in the advent of an atomic attack on the United States. With more than 20% of the rubber goods manufacturing personnel, including top management and technical directors, located in the Akron, O., area, and 30% in the State of Ohio, this branch of the industry is particularly vulnerable to such attack, as pointed out in the lead article in this issue by Neil P. Hurley, S. J.

The United States Government has been concerned with the vulnerability of essential American industries to atomic attack since the end of World War II, in view of the very great destructive power of such weapons. The National Industrial Dispersion Program, which was designed to disperse new defense industries as much as possible, was announced in 1951. As an incentive to such dispersal, the rapid tax write-off privilege was initiated in 1952 in an attempt to encourage decentralization of defense industries.

Unfortunately, the certain arbitrary criteria and exceptions to the rules for location of defense plants under the rapid tax write-off plan have resulted in much less than the desired amount of decentralization during the past several years, *particularly in the rubber and associated industries.*

Most of the synthetic rubber producing facilities are located adjoining petroleum processing areas on or near the coast in the Southwest, East, and Far West, and the chemical and machinery supplier plants to the rubber goods fabricating industry are also located in Federal Civil Defense Administration critical target areas.

Obviously, dispersal of existing plants is not possible; neither is dispersal which is contrary to the normal economic factors of doing business profitably. New plants for synthetic rubber, rubber products, and chemicals and machinery essential to the operation of the rubber industry will be built during the next few years, however, if recent predictions regarding the growth rate of the rubber industry are confirmed. *If more attention is given to some of the existing plans for dispersal of essential defense industry plants, such as the Project East River Commision Report, the industry will be paying its first premiums on "atomic survival insurance."*

The most recent 84th Congress has extended the Defense Production Act of 1950 until 1958, with the amendment that the principle of geographic dispersal must be applied in the construction of government owned plants, in giving financial aid for the construction and improvement of industrial facilities, and in the procurement of goods and services under the Act "or any other act." It is not unlikely that the Office of Defense Mobilization may take a somewhat closer look now before approving sites for new plant construction.

The rubber goods fabricating industry has been undergoing a certain amount of decentralization for economic reasons because of the desire for locations nearer to synthetic rubber production facilities, because of new market areas that have developed in recent years, and availability of labor. *Decentralization for economic reasons can also serve strategic defense purposes.*

R. G. Seaman

EDITOR

Meetings and Reports

Rubber Division, ACS, Meeting Program; Joint Symposium on Literature Included

The fall meeting of the Division of Rubber Chemistry of the American Chemical Society will be held in Atlantic City, N. J., September 19-21, at the Chalfonte-Haddon Hall Hotel, as a part of the meeting of the parent Society. The Rubber Division is also sponsoring a symposium entitled, "The Literature of Rubber," with the Division of Chemcal Literature which will be held on the afternoon of the 18th and the morning of the 19th. The Rubber Division's regular program will commence on the afternoon of the 19th and will be featured by the Goodyear Medal Award Lecture for 1956 to be presented on the morning of the 20th by Sidney M. Cadwell, United States Rubber Co. Presentation of the Goodyear Medal will be made to Dr. Cadwell at the banquet the same evening.

The technical sessions of the Rubber Division will begin at 2:00 p. m., Wednesday afternoon, September 19, with A. E. Juve, B. F. Goodrich Co., Division chairman, presiding. This first session will consist of papers on new polymers. At the second technical session on Thursday morning, September 20, B. S. Garvey, Jr., Sharples Chemicals Division, Pennsylvania Salt Mfg. Co., will preside, and this session will include papers on oxidation and aging, the business meeting of the Division, and Dr. Cadwell's address. The third session on Thursday afternoon will be devoted to papers on carbon black, with D. C. Maddy, Harwick Standard Chemical Co., director-at-large, presiding. The fourth and final session on Friday morning will consist of papers on compounding and testing, and A. J. Northam, E. I. du Pont de Nemours & Co., Inc., chairman of the local committee on arrangements, will preside.

Other members of the local committee on arrangements for this meeting include T. K. Cox, Western Electric Co., vice chairman and treasurer; T. W. Gorman, Quaker Rubber Corp.; T. W. Elkin, R. T. Vanderbilt Co.; J. B. Johnson, Linear, Inc.; and D. B. Forman, Du Pont.

A luncheon-meeting of the Division's 25-Year Club will be held on September 19. Chairman for this meeting will be E. R. Bridgwater, Du Pont. Assembly will be at 11:30 a.m.., and luncheon is scheduled for 12:30 p. m.

The banquet of the Division is to be held on the evening of September 20 and will be preceded by the Suppliers Cooperative Cocktail Party. Members, guests, and ladies are invited to the banquet and the cocktail party. The banquet will be featured by the presentation of the Goodyear Medal to Dr. Cadwell, and good food, good service, and a good show have been promised also.

The technical sessions, registration, and the ladies' program will be under the jurisdiction of the parent society at this meeting.

Abstracts of Papers

Wednesday Morning—September 19

9:00 a.m.—Registration.

12:30 p.m.—25-Year Club Luncheon-Meeting. E. R. Bridgwater, chairman.

Wednesday Afternoon—September 19

New Polymers

A. E. Juve, Presiding

2:00 p.m.—1. Introductory remarks. A. E. Juve.

2:05 p.m.—2. Cross-Link Density in Ungelled Polybutadiene. L. H Howland,[1] A. Nisonoff, L. E. Dannals, V. S. Chambers, Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

A thorough knowledge of the structure of polymers such as polybutadiene made by emulsion polymerization should aid in devising methods of improving the product made in such a system. Considerable work has been done in the past in determining configuration features in polybutadiene including some work on cross-linking. It has been felt, however, that considerable more knowledge on the latter feature was desirable. In view of this, cross-linking has been studied in polybutadiene below the "gel point," using the radioactive modifier technique.

A number of polymerization features including polymerization conditions and recipe changes were investigated, and a number of facts were noted, some of which follow: When low molecular weight polymers were compared, the cross-link density was almost linear with polymerization temperature. However, at 50 or 5° C. it increased with increased average molecular weight of the polybutadiene; while at −18° C. it did not appear to change very much with molecular weight. The high molecular weight fraction of a low molecular weight 5° C. polybutadiene did not differ appreciably in cross-link density from the whole polymer. In the region studied, conversion did not appear to be an important factor in determining cross-linking. In addition, there was no significant difference in cross-linking caused by organic hydroperoxide catalysts as compared to inorganic peroxide catalysts.

[1] Name in bold face indicates person presenting paper.

2:30 p.m.—3. Properties of a New Fluorine-Containing Elastomer. J. S. Rugg and S. Dixon, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

This new elastomer is a stable colorless material soluble in ketones. The product responds to curing agents, such as polyamines or organic peroxides, to produce strong, elastic vulcanizates. The vulcanizates have unusual resistance to deterioration at temperatures of 400 to 500° F. when in contact with air, petroleum oils, diester lubricants, and ester hydraulic fluids.

The gum may be mixed with carbon black, silica, and other fillers to improve processability and vulcanizate properties. Compounded stocks can be shaped by molding, extrusion, calendering, or deposited from solutions. A vulcanization temperature of 400° F. is necessary to develop the best mechanical properties and resistance to aging. In practice, this is accomplished by a partial cure in a mold at 300° F., followed by an oven cure at 400° F.

Possible applications for this elastomer include heat- and fluid-resistant O-rings, gaskets, wire covering, and protection against corrosive chemicals.

2:55 p.m.—4. Rubbery Polymers and Copolymers Prepared with the Use of Complex Metal Catalysts. Robert S. Aries, Robert S. Aries & Associates, New York, N. Y.

Using a catalyst prepared by the action of butyl lithium in $TiCl_3$, butadiene is polymerized in octane solution at 80° C. to, poly-*cis*-butadiene, which is a rubber with an osmotic M.W. of about 220,000. In the stretched state, it gives a good fiber diagram with an identity period parallel to the fiber axis of 8.75 A. Cured with a standard recipe, the rubber has a tensile strength of 5240 psi., elongation of 820%, excellent recovery and small heat built-up. It has better resistance to oxygen and solvent action than natural rubber.

Copolymers of ethylene and propylene containing 1.5 to 3.0% of isoprene prepared with the aid of a catalyst from aluminum triisobutyl and $TiCl_3$ in tetralin at 90° C. are amorphous rubbery plastics at room temperature and relatively snappy rubbers above 60° C. Cured with a butyl-type rubber recipe, they yield rubbers resembling butyl rubber in resistance to oxygen and heat, but have a better rebound. Copolymers of ethylene and butene-1 containing a few % of isoprene are very similar to butyl rubber.

3:20 p.m.—5. Compounding Silicone Rubber for Minimum Shrinkage. J. J. Deasy and B. B. White, General Electric Co., Waterford, N. Y.

New technology in the compounding of silicone rubber has resulted in compounds that have shrinkage equivalent to hydrocarbon rubber stocks. It is expected that such technology will be a definite contri-

bution to the industry, particularly that segment producing O-rings. One benefit is reduced tooling costs because certain silicone rubber compounds can be molded in standard O-ring molds.

This technology is described in a study of the shrinkage of a certain mixed filler system in methyl siloxane-type polymers. Combinations of these reinforcing fillers with proper selection of siloxane polymer make possible compounds with shrinkage equal to that of hydrocarbon rubber compounds commonly used in the production of molded mechanical goods.

The effect of molding temperature on shrinkage is demonstrated with data from production runs of O-rings molded from 260 to 340° F. This temperature range, double that usually associated with silicone rubber, is possible through the choice of curing agents such as bis, 2,4 di-chlorobenzoyl peroxide, dicumyl peroxide, and ditertiary butyl peroxides. Correlation of molding temperature, thermal expansion, Mooney cure rate, and dielectric strength with shrinkage is given, and the significance of each is discussed.

Graphic data illustrating the shrinkage equivalency of a silicone and a nitrile compound in the same production O-ring mold are discussed.

3:45 p.m.—6. Vulcanization of Silicone Rubber. J. R. Harper, A. D. Chipman, G. M. Konkle, Dow Corning Corp., Midland, Mich.

Increasing interest in the compounding of silicone rubber by individual fabricators, coupled with an increase in the number and complexity of factors involved in silicone rubber applications, has stimulated an interest in more information on the various phases of compounding. It is the purpose of this paper to investigate one phase of compounding, viz., the vulcanization of silicone rubber. Such vulcanizing agents as benzoyl peroxide, dichlorobenzoyl peroxide, ditertiary butyl peroxide, dicumyl peroxide, tertiary butyl perbenzoate, and others can be used in conjunction with dimethyl siloxane polymers as well as vinyl methyl siloxane copolymers.

Specific advantages as well as disadvantages are found for each type of agent with regard to such properties as durometer hardness, tensile strength, elongation, compression set, tear strength, shrinkage, and other more specialized properties. The presence or absence of vinyl groups in silicone rubber polymers also affects behavior with different peroxides. Recommendations with regard to amount and type of agent are made with each type of silicone polymer for particular applications. Optimum conditions for molding and curing are also included.

4:10 p.m.—7. Carbon Black-Filled Silicone Rubber. C. L. Bitner and M. L. Dunham, Union Carbide & Carbon Corp., Tonawanda, N. Y.

Carbon black-filled silicone rubber compounds can now be satisfactorily cured when vinyl-containing silicone gum stocks and a di-tert-alkyl peroxide curing agent are used. The reinforcement obtained is dependent on the nature of the carbon black. Physical properties comparable to silica-filled silicone rubbers can be obtained. Proper selection and loading of the di-tert-alkyl peroxide permit a choice of steam, hot air, or mold curing of fabricated parts. Data summarizing the physical and electrical properties obtained with furnace, channel, acetylene, and battery blacks in both general-purpose and extreme low-temperature vinyl-containing gums cured with either of two di-tert-alkyl peroxides are presented.

An outstanding feature of these black-filled elastomers is the high electrical conductivity. This conductivity is somewhat dependent on the black loading, but is unaffected by milling or fabricating procedures. Data which show that the cured elastomers maintain their high conductivity after repeated flexing, under high extension, and at elevated temperatures are included. Properties associated with silica-filled stocks, such as thermal stability and adhesiveness, are not compromised. The stocks are easily fabricated and can be deposited from solution. A mixed silica-carbon black filler system may be used to vary the conductivity or processing properties. Potential applications include heating jackets and blankets, grounding shields, hospital goods, and antistatic or heated rolls.

4:35 p.m.—8. Tack of Pressure-Sensitive Tape. Franklin S. C. Chang, Mystik Adhesive Products Co., Northfield, Ill.

Tack as defined for printing ink[2] is inadequate for pressure-sensitive tape. It is defined as the force required to pull a tape from a standard surface with the free end of tape forming an angle of 90 degrees to the surface; the tape is applied to the surface under the weight of the tape only. The standard method for measuring adhesion strength (ASTM D1000-48-T) was modified to determine tack. This modified method proves to be a good substitute for the empirical finger test and puts tack testing on a quantitative basis.

The results obtained are precise enough for practical purposes and reproducible. It seems that a straight-line relation exists between tack and thickness of adhesive film as measured by the amount of adhesive applied. This straight line is probably a characteristic of the chemical nature and physical condition of the adhesive.

Thursday Morning—September 20

Oxidation and Aging

B. S. Garvey, Jr., Presiding

9:00 a.m.—9. Formation of Microgel during Accelerated Aging of Neoprene Latex. Kurt L. Seligman, Jackson Laboratory, du Pont.

Gelation of polychloroprene during aging of polymer latices has been postulated to occur via cross-linking at sites where 1,2-addition has occurred during polymerization. Evidence is presented which indicates formation of microgel during accelerated aging of latices. During aging, polymer intrinsic viscosity decreases, and light scattering measurements show increased scattering intensities. These data which indicate microgel formation are further supported by sedimentation studies on ultracentrifuged polymer solutions. The effects of microgel on the nerve, viscosity, and vulcanizate properties of polymer isolated from the aged latex are discussed.

9:25 a.m.—10. Chain Scission Efficiency in the Oxidation of Natural Rubber Vulcanizates. A. G. Veith, B. F. Goodrich Research Center, Brecksville, O.

The efficiency of the oxidative chain scission in natural rubber vulcanizates has been measured by a simple MBTS vulcanizate with and without antioxidants. This was accomplished by making concurrent measurements of the chain-scission velocity and oxidation rate. The chain-scission velocity was obtained from stress relaxation measurements corrected for the relaxation not due to oxygen, by means of relaxation in vacuo. The reciprocal scission efficiency, defined as the number of molecules of O_2 per chain scission, was found to be 1.5 as a mean for six vulcanizates both with and without antioxidant.

The decrease in network chains was found to be first order. From the theoretical analysis by Bueche, on the problem of chemical or degradative stress relaxation, such behavior has been interpreted to indicate a non-random scission process. The non-random scission takes place at the cross-linked site. The form of the dependence of the reciprocal scission efficiency on time, in vulcanizates with and without antioxidant, is consistent with non-random scission. Experiments on butyl rubber vulcanizates and the known effect of cross-link density or combined sulfur on oxidation rate further strengthen the concept of scission at the cross-linked site.

9:50 a.m.—11. Chain Scission in the Oxidation of *Hevea*. IV—Low Molecular Weight Products from Dry Rubber. E. M. Bevilacqua, U. S. Rubber, Passaic, N. J.

The yields of identifiable products from the oxidation of dry rubber are compared in this paper with previously determined yields from the oxidation of latex. In the first two papers of this series, a tentative reaction mechanism was outlined for the scission of *Hevea* rubber by molecular oxygen, based on quantitative estimation of volatile products associated with the scission reaction, in latex. The experiments with dry rubber at temperatures of 120-140° have led to improvements in the original mechanism, which now appears to account for the scission phenomenon nearly quantitatively.

10:15 a.m.—12. Carbon Black in the Oxidation of Styrene-Butadiene (SBR) Vulcanizates. J. Reid Shelton and Wm. T. Wickham, Jr., Case Institute of Technology, Cleveland, O.

The many conflicting statements in the literature regarding the effect of carbon black in the oxidation of SBR vulcanizates suggested a reexamination of the problem. The accelerating effect of carbon black upon the rate of oxygen absorption was confirmed. This effect cannot be explained as merely due to removal of antioxidant by adsorption on the black, since the effect was also observed with uninhibited stocks. Low loadings of carbon black decreased the rate of oxidation in certain cold rubber vulcanizates. Evidence of interaction

[2] H. Green, *Ind. Eng. Chem., Anal. Ed.*, 13, 632 (1914); and A. Voet, C. F. Geffken, *Ind. Eng. Chem.*, 43, 1614 (1951).

of iron and carbon black was observed in that the usual accelerating effect of each on the oxidation reaction was diminished in the presence of the other.

The results of this study, together with other evidences from the literature, suggest that carbon black may function in several ways to alter the rate of oxidation. The net effect would then depend upon the relative magnitude of the individual effects in the vulcanizate in question under a given set of conditions. Acceleration of the rate by carbon black may be attributed to surface catalysis of the oxidation reaction, catalysis of peroxide decomposition to free radicals, adsorption of antioxidant, and (at appropriate temperatures) increased solubility of oxygen. Inhibition of oxidation by carbon black may be attributed to carbon acting as a free-radical acceptor, induced decomposition of peroxide to stable products, and deactivation of metal catalysts of oxidation.

10:40 a.m.—13. Resistance of Rubber Compounds to Outdoor and Accelerated Ozone Attack. C. V. Lundberg, G. N. Vacca, B. S. Biggs, Bell Telephone Laboratories, Murray Hill, N. J.

Rubber compositions consisting principally of styrene-butadiene rubber (SBR) and a lesser number of neoprene formulations have been statically exposed outdoors in Los Angeles, Calif., Murray Hill, N. J., and Yuma, Ariz., for 18 months. Exposures were initiated in the summer in all three locations as well as in the late fall in Los Angeles and Murray Hill. Observations of ozone cracking have been made periodically, and these observations have been correlated to show the relative severity of atmospheric ozone cracking at the three locations. The compounds which crack develop cracks in a shorter exposure time at Los Angeles than at Murray Hill, but at the expiration of 18 months' exposure the percentage of uncracked specimens in each location is in good agreement.

The same compounds have been statically exposed in ozone chambers operating at three different temperatures: namely, 100, 110, and 120° F., the first one at 50, and the second and third at 25 parts ozone per hundred million of air. The data obtained in the chamber exposures have been correlated with the outdoor observations.

An additional group of compounds consisting of natural, nitrile, SBR, and butyl rubber formulations has been exposed outdoors at Murray Hill and in the chambers to determine the relative behavior of these materials. The neoprene compounds in the first test, as well as the natural, the nitrile, and the 2½ and 3% unsaturated butyl compounds in the additional exposures, show good correlation of outdoor ozone crack resistance data with chamber data. The 1% and 2% unsaturated butyl and the SBR compounds show less correlation between outdoor and chamber results.

The relative effectiveness of waxes, antiozonants, higher than normal concentrations of antioxidants, and combinations of such protective agents in the four polymers is discussed.

11:00 a.m.—Business meeting.

11:15 a.m.—14. Goodyear Medal Lecture: Scientific Contributions to the Rubber Industry. S. M. Cadwell, U. S. Rubber, New York.

A. J. Northam, local committee chairman

Thursday Afternoon—September 20

Carbon Black and Processing
D. C. Maddy, Presiding

2:00 p.m.—15. The Chemistry of Reinforcement. I—Some Reactions between Carbon Black and Simple Inorganic Molecules. M. L. Studebaker, Phillips Chemical Co., Akron, O.

The mechanism by which carbon blacks reinforce rubbers has been the basis of extensive research work. One of the phases of this work relates to a study of reactions between the carbon black molecule and chemicals, either those which are present in the elastomer or which are produced during the vulcanization step.

In an attempt to elucidate further this problem the authors have carried out chemical investigations on the reactivity of various types of carbon black with a variety of simple inorganic molecules such as hydrogen, ammonia, hydrogen sulfide, and sulfur.

A limited amount of data is also presented showing the effect on the physical properties of rubber vulcanizates of utilizing carbon blacks pretreated with certain of these inorganic compounds. On the basis of this preliminary work it would appear that reactions involved in the vulcanization process have a marked effect upon the reinforcing properties of the carbon blacks.

2:25 p.m.—16. Carbon Blacks for Highly Conductive Rubber. M. H. Polley and B. B. S. T. Boonstra, Godfrey L. Cabot, Inc., Boston, Mass.

A survey is given of the various parameters determining the electrical conductivity of carbon black-loaded rubber stocks. Factors such as particle size, nature and extent of the surface, concentration, degree of dispersion, particle-to-particle structure, and vulcanization reaction are discussed in connection with the explanation commonly used for the phenomenon of conductivity of black dispersions. The theoretical aspects of the conductivity of these dispersions are briefly reviewed, and a simple distribution model is discussed.

By a combination of the properties most favorable for high conductivity, a new, unique grade of black has been developed, designated as Vulcan XC-72. Vulcan XC-72 imparts greater electrical conductivity to rubber than any presently available commercial grade of carbon black and extends the range of applications of conductive high polymers.

2:55 p.m.—17. The Organic Nature of Carbon Black Surfaces. J. V. Hallum, Mellon Institute of Industrial Research, Pittsburgh, Pa.

The possibility of the existence of reactive functional groups on the surface of carbon blacks which may contribute to the total reinforcing action in rubber is an intriguing problem. The results of preliminary studies to determine the existence of these groups are reported in this paper. Direct evidence for the existence of hydroxyl groups and carbonyl groups present as quinone carbonyl on the surface of some carbon blacks is given.

While the use of infrared analysis of carbon blacks is impractical in general, a carbon black of high oxygen content and of 8-10 microns diameter was found which gave an interpretable infrared curve. Bands were noticed on the curve corresponding to either aromatic nuclei or hydrogen-bonded, conjugated carbonyl groups. Treatment of this black with diazomethane caused a shift of this band to a wave length corresponding to that of non-hydrogen bonded carbonyl groups.

With this as evidence, a study was begun using the polarograph as the analytical tool. Waves with half-wave potentials in a range assignable to quinone carbonyl were noted. In order to prove that these waves were not due to a peculiar reaction of the electrolyte, the reduction potentials were measured, using a different salt. Blacks were extracted with the solvent, and the extracts examined in order to show that the reduction potentials observed were not due solely to functional groups in the extractable material. A mechanism for the reaction of elastomers with carbon blacks is tentatively proposed in view of the foregoing.

3:20 p.m.—18. Infrared Study of Some Structural Changes in Natural Rubber during Vulcanization. Frederic J. Linnig and James E. Stewart, National Bureau of Standards, Washington, D. C.

Infrared studies have been made of natural rubber vulcanized with sulfur alone and also with sulfur and various accelerators. The spectral change (appearance of band at 10.4 microns) resulting from the double-bond shift observed by Sutherland was verified for compounds containing 2% or more of sulfur. The presence of conjugated double-bonds in compounds containing 5% or more of sulfur has been indicated spectroscopically (appearance of band at 6.25 microns) and proved chemically with the aid of studies performed with squalene-sulfur reaction product and maleic anhydride.

Conjugation probably results from two double-bonds in adjacent monomer units shifting toward each other along the chain.

Sutherland has shown the double-bond shift to be correlated with the amount of combined sulfur. Zinc dibutyldithiocarbamate (BZ) increases very greatly the rate of the double-bond shift and reduces markedly the time required for conjugation to appear. However, the amount of double-bond shift occurring in BZ accelerated compounds before conjugation appears is more than that which occurs in unaccelerated compounds. Thus, one of the effects of BZ acceleration is to delay the appearance of conjugation relative to a given amount of double-bond shift. Moreover, further vulcanization of these compounds does not cause so great an increase in the amount of conjugation as is caused with unaccelerated compounds. Tetramethylthiuram disulfide (TMTD) increases the rate of the double-bond shift, though to a lesser extent than BZ. TMTD, however, seems to prevent completely the appearance of conjugation. Accelerated compounds also show evidence of reduced carbonyl structure and increased absorption due to OH or NH.

Conjugated systems are highly reactive. It is therefore conceivable that the foregoing is related to the fact that rubber-sulfur vulcanizates degrade more readily to accelerated compounds and that compounds containing TMTD are relatively quite resistant to aging. Compounds cured with TMTD alone, peroxides, gamma-rays, or sulfur dioxide and hydrogen sulfide (Peachey process) do not show definite evidence of the double-bond shift or conjugation, but show increased OH or NH absorption, decreased carbonyl structure, and, in the case of the last three, the presence of ionized carboxyl or nitrate groups. Apparently, the double-bond shift and conjugation are primarily phenomena related to the use of elemental sulfur.

3:45 p.m.—19. A Non-Blooming, High-Temperature-Resistant Vulcanizing Agent for Natural and Synthetic Rubbers. K. R. Cranker and V. H. Perrine, Thiokol Chemical Corp., Trenton, N. J.

VA-7 is a new liquid vulcanizing agent containing sulfur in a combined state which is available for vulcanization. Outstanding features of this product include such properties as its ease of dispersion, non-blooming in cured and uncured stocks, and the excellent heat aging of the cured rubbers at 250 to 300° F. Stocks may be readily compounded, insuring intimate contact between the vulcanizing agent and rubber. Because of its ease of dispersion, VA-7 has gained recognition as a vulcanizing aid for white sidewall applications.

Compounds vulcanized with VA-7 for molded goods applications display excellent retention of tensile strength and flexibility in hot oils at 250° F. Benzothiazyl disulfide, litharge, and Methyl Zimate[3] may be used for acceleration of the VA-7 cures. The combination of VA-7 with a small amount of Methyl Zimate will produce rapid cures of natural, nitrile, and styrene-butadiene rubbers. VA-7 is moderately priced, and relatively small amounts are required for complete vulcanization. Applications for which VA-7 is being used successfully include synthetic cements, mechanical goods, printing plates and rolls, and numerous hot oil applications.

Friday Morning—September 21
Compounding and Testing
A. J. Northam, Presiding

9:00 a.m.—20. Influence of Petroleum Oils on Staining and Discoloration of Elastomers. Henry M. Tramutt and Ervin G. Anderson, Gates Rubber Co., Denver, Colo., and F. S. Rostler and R. M. White, Golden Bear Oil Co., Oildale, Calif.

The study reported in this paper was prompted by the increasing interest of compounders in stocks which are white or light colored or are designed to be in contact with such stocks. Since a number of petroleum oils are used as plasticizers or extenders for all widely used polymers, the investigation was designed to establish some generally valid facts regarding the influence of the oils on color stability and staining characteristics.

Oils representative of compositions of currently used petroleum oils and compounds based on natural rubber, SBR, butyl rubber, nitrile rubber, neoprene, "Hypalon," and polyvinyl chloride containing the various oils were tested as to discoloration and migration-staining on exposure to sun lamp aging and roof aging. A conventional white sidewall compound was included in the tests as a reference.

Since all rubber compounds discolor to some extent, and since the permissible degree of discoloration varies with the intended use of the compounds, permissible levels for components of the oils vary with each type of compound. The method employed in this investigation of defining petroleum oils by content of nitrogen bases, first acidaffins, second acidaffins, and paraffins and of using % reflectance to define discoloration is shown to be a suitable method for establishing permissible limits for composition of oils to be used with various polymers.

The accuracy obtainable appears to be greater than by defining oils as "naphthentic," "aromatic," and "highly aromatic." Some oils classified by the former Government office of Synthetic Rubber nomenclature as "aromatic oils," i.e., oils containing only negligible amounts of paraffins, were found to be non-staining and non-discoloring in compounds for which previous work stipulated a threshold level of only 30 to 40% "aromatics." It was also found that color and color stability of an elastomer compound containing an oil cannot be predicted from the color or color stability of the oil itself.

Results of the investigation are presented in tables and graphs. The color phenomena discussed are depicted by color slides.

9:25 a.m.—21. Compounding Rubbers for Resistance to Silicate-Ester—Type Hydraulic Fluids at 400° F. I—Neoprene WRT. L. E. Novy and R. A. Clark, Battelle Memorial Institute, Columbus, O.

This research was sponsored by the Wright Air Development Center in order to develop rubber compositions with resistance to hydraulic oils of the silicate-ester type. The objective was a rubber composition which would retain satisfactory physical properties after 500 to 1000 hours' immersion in such fluids at 400° F. One of the requirements was that the composition should have a brittle point of at least −65° F., both before and after prolonged oil aging. The silicate-ester fluids were developed for use in aircraft operating at temperatures too high for conventional petroleum-base oils. Neoprene WRT compounds were the best prior compositions that had been developed, but they remained serviceable for only three to four days when immersed in silicate-ester fluid at 400° F. Therefore an effort was made to extend the service life of neoprene compounds.

Neoprene compounds were developed which offer advantages over previously reported compounds. The most successful ones were either partially or totally reinforced with non-black filler, plasticized with butyl oleate, and vulcanized with a combination of magnesia, zinc oxide, and NA-22.[4] While the tensile strengths of such compounds were usually lower than those of more conventional black-filled compositions, they were superior in their ability to retain rubber-like properties after hot oil aging. As a result of this compounding study, the service life of Neoprene WRT was approximately doubled for this application.

9:50 a.m.—22. Compounding Rubber for Resistance to Silicate-Ester-Type Hydraulic Fluids at 400° F. II—Nitrile, Vinyl Pyridine, Butyl Rubber, and Acrylate Polymers. W. J. Mueller and R. A. Clark, Battelle Memorial Institute, Columbus, O.

The above-mentioned types of polymers were compounded and evaluated for their resistance to silicate-ester type hydraulic fluids. Among these polymers, a butadiene-vinyl pyridine copolymer (Philprene VP-25)[5] and a butadiene-vinyl pyridine-acrylonitrile terpolymer (Philprene VP-A)[5] were the most promising for hot-oil aging periods up to 168 hours. Their performance, however, was not quite so good as that of neoprene, discussed in Part I of this paper. An outstanding property of these vinyl pyridine-type polymers was their excellent low-temperature resistance. One of the best compositions was reinforced with Cab-o-sil[6] and cured with sulfur, tetramethylthiuram disulfide, and a quaternizing agent such as benzotrichloride. When the aging period was extended beyond 168 hours, even the best compositions with this-type polymer hardened and cracked when bent double.

For longer hot-oil aging periods (336 to 500 hours), the best results were obtained with Acrylon BA-12[7] stocks. Although the tensile strength of this polymer was low, even before aging, it did not harden or crack because of aging. The best results were obtained with stocks reinforced with either Philblack A or Hi-Sil,[8] and vulcanized with a combination of sulfur, tetramethylthiuram disulfide, and triethylene tetramine. The inferior tensile strength probably can be improved by further studies with reinforcing fillers. The best nitrile rubber stock (Hycar 1014)[9] was

[3] R. T. Vanderbilt Co., New York, N. Y.
[4] E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
[5] Phillips Chemical Co., Akron, O.
[6] Godfrey L. Cabot, Inc., Boston, Mass.
[7] American Monomer Corp., Leominster, Mass.
[8] Columbia-Southern Chemical Corp., Pittsburgh, Pa.
[9] B. F. Goodrich Chemical Co., Cleveland, O.

reinforced with Hi-Sil and vulcanized with small amounts of sulfur and tetramethylthiuram disulfide. After hot-oil aging only 72 hours, this stock became hard and cracked when bent double. Butyl rubber vulcanizates were found to be entirely unsuitable for this application, as they disintegrated during aging.

This work indicates ways in which commercially available polymers can be upgraded to increase their resistance to silicate-ester-type hydraulic fluids at 400° F. For hot-oil aging periods up to 168 hours, Neoprene WRT gave the best results. For longer aging periods, Acrylon BA-12 gave much better resistance to cracking and is believed to show more promise.

10:15 a.m.—23. The Physics of the Friction of Rubber on Rough Surfaces. F. W. Boggs and W. P. Rieman, U. S. Rubber, Passaic.

Friction, which leads to traction of tires on dry pavement, is not only of great technical importance in itself, but it is also a measure of the forces which lead to abrasion. Therefore, a study of how friction varies with slip should help us understand rubber loss in tires as well as their traction.

To permit the simultaneous measurement of friction and abrasion, a Lambourn type of abrador was constructed in which the frictional forces could be measured. This machine is similar to previous designs except for the brake. Instead of using a hydraulic brake or a Foucault current disk, a DC motor driven as a generator with external field excitation was employed. The current in the armature is a measurement of the torque and consequently the friction force.

It was found that if this force expressed in dimensionless terms is plotted as a function of a dimensionless variable involving slip, hysteresis, and modulus, a universal curve is obtained which governs all the rubbers examined. The dimensionless quantities were obtained by sealing the equations governing the reaction of rubber to a time dependent stress. The physical significance of the shape of this curve and its bearing on the mechanism of friction and abrasion will be discussed.

10:40 a.m.—24. Elasticity and Break of Compounded Rubbers. H. K. de Decker, U. S. Rubber, Passaic.

To obtain a rough quantitative picture of the reinforcing effect of fillers in rubbers, simple physical and geometrical assumptions about the molecules and the filler particles were used. These will be used to describe theoretically the experimental stress-strain curve of rubbers, without considering the best definition of reinforcement.

The stress-strain curves for black reinforced *Hevea* and SBR differ typically from those for the corresponding pure gum compounds. These differences are found in the theoretical curves, as will be shown, and it may therefore be concluded that some essential features of reinforcement have been lucidated. The general value of this simple theory will be illustrated by calculation of the properties of *Hevea* and SBR, both pure gum and black reinforced, and by brief indications of the calculations to be made in other cases.

The quantitative results obtained for SBR and *Hevea* must be considered as preliminary, since much has still to be done to ascertain more correct values for the molecular quantities involved. This will be possible by means of the methods described. It is expected that ultimately these molecular quantities will prove more valuable in characterizing rubber vulcanizates than the conventional macroscopic data such as tensile strength, etc.

11:10 a.m.—25. A Study of Factors Affecting the Laboratory Cut-Growth Resistance of LTP SBR Tread Stocks. E. E. Auer and I. J. Schaffner, U. S. Rubber, Passaic.

The significance of the laboratory cut-growth test of SBR tread stocks can be increased appreciably by determining the cut-growth resistance of each compound tested over a wide range of cures and plotting the results as a function of modulus. The curves fitted to the data thus obtained have a high degree of reproducibility.

Utilizing this technique, it has been found that, over the 300% modulus range (M of 800 to 2800 psi.), the cut-growth resistance at 150° F. (expressed as kilocycles per inch—kc/in.) of LTP SBR tread stocks approximates the following relation:

$$\log (\text{kc in.}) = a - b\,(M)$$

The parameters, a and b, remain virtually constant for a tread stock having a fixed loading of any given type of carbon black, regardless of the nature and the amount of antioxidant or accelerator used in compounding and regardless of the extent of air aging of the vulcanizate.

With any given black the parameters, a and b, vary greatly with black loading. When, however, the cut-growth resistance is plotted as a function of breaking elongation (E), the results approximate the equation:

$$\log (\text{kc in.}) = \alpha + \beta\,(E)$$

in which α and β are nearly independent of black loading. The cut-growth resistance is thus related to breaking elongation.

11:35 a.m.—26. Evaluation of ISO Micro Hardness Tester. Ross E. Morris and John M. Holloway, Rubber Laboratory, Mare Island Naval Shipyard, Vallejo, Calif.

The micro hardness tester sponsored by the International Standards Organization has been investigated to determine its usefulness for rubber testing. This instrument is an indentometer and is basically similar to the ASTM hardness tester. All parts of this instrument, however, are smaller and lighter than those of the ASTM hardness tester, and the movement of the indentor is measured with a microscope instead of a micrometer gage. The purpose of the micro hardness tester is to obtain a hardness measurement on rubber items which are too small, thin, and odd-shaped for testing with the usual instruments.

It was found that the micro hardness tester, as designed, was less sensitive than the Shore A durometer for the higher hardnesses of rubber, but was more sensitive for the lower hardnesses. The sensitivity for higher hardnesses was improved by increasing the weight on the indentor. The readings of the micro hardness tester showed progressively lower values, as much as 20% lower, when the thickness of the specimens of the same vulcanizate was decreased from ½-inch to 1/64-inch. The agreement within a series of repeat measurements made on the same shape and size of rubber specimen was acceptable.

It was concluded that the micro hardness tester is suitable for testing small, odd-shaped rubber items provided that (1) a flat or convex upper surface is available for testing; (2) the item is supported on a special mandrel when necessary; and (3) the weight on the indentor is increased when harder rubbers are being tested.

Akron Group Outing

Highlighted by a record turnout of 975 members, the Akron Rubber Group held its annual summer outing at the Firestone Country Club, Akron, O., June 15. A strolling band was one of the features of the affair.

John Cseh, Firestone Tire & Rubber Co., achieved the lowest gross score in the golf tournament; while John Rowe, Firestone, took top honors for the longest drive and accuracy. J. B. Cook, Wooster Rubber Co., also won an accuracy award. Blind bogey winners were R. B. Sherwood, B. F. Goodrich Co.; Clyde Brenneman, Wooster; and F. E. Toonder, Columbia-Southern Chemical Corp.

Chairman of the outing committee was George Popp, Phillips Chemical Co., who was assisted by Mel Vaughn, Witco Chemical Co.; Maynard Bobbitt, Firestone; L. V. Cooper, Firestone; Cather Louthan, Godfrey L. Cabot, Inc.; Bob Whipple, Firestone; and Bill Campaign, Goodyear Tire & Rubber Co.

S. C. Nicol, Goodyear, chairman of the Group's membership committee, reported a membership of 1,800 for the current year.

Industry Show at Detroit

A management-engineering conference by a panel of manufacturing experts will cover new ideas for industry in the fields or rubber, plastics, chemicals, and textiles at a "non-metallics day," October 26, during the National Industrial Exposition at the Detroit Artillery Armory, Detroit, Mich.

The conference will be moderated by editors of industrial publications. Similar conferences will be held in other fields during the run of the exposition, October 22-26.

October 23 will be devoted to the manufacturing processes; October 24, to the electronic and atomic fields; and October 25, to the newest developments in the metals and metal product industries.

Further information may be obtained from the headquarters of the exposition, 927 Book Bldg., Detroit 26.

"Literature of Rubber" Symposium by Chemical Literature and Rubber Divisions

A special feature of the American Chemical Society meeting in Atlantic City, N. J., during the week of September 16, will be a symposium sponsored jointly by the divisions of Chemical Literature and Rubber Chemistry, entitled "The Literature of Rubber." The program will consist of two sessions, one on the afternoon of September 18, and the other on the morning of September 19.

Miss Hanna Friedenstein, Godfrey L. Cabot, Inc., has been in charge of the development of the program, and she will preside at both sessions. Subjects of some of the papers of special interest to the rubber industry include: the literature of natural, synthetic and reclaimed rubber; patent searching, standards, and specifications; government reports; market information, etc.

The program and abstracts of papers to be presented are given below.

Program and Abstracts of Papers

Tuesday Afternoon—September 18
The Literature of Rubber
Miss Friedenstein, Presiding

2:00 p.m.—1. Introductory Remarks. Miss Friedenstein.

2:05 p.m.—2. The Jargon of the Rubber Industry. S. G. Byam, E. I. du Pont de Nemours & Co., Inc., elastomers division, Wilmington, Del.

The jargon of the rubber industry, like the lingo, cant, or argot of any specific group or industry, consists chiefly of common words or phrases to which special and not common meanings are ascribed. To individuals within the group or industry, jargon is colorful and expressive, often connoting ideas or effects difficult to describe in more precise language. For instance, "nerve" in rubber parlance suggests a condition familiar to every rubber man, but so difficult to define adequately that no completely acceptable method of testing for it has been devised. The meaning of jargon often depends on context, as a word can have several meanings. "Cure" means to vulcanize. It is also used to mean the condition bringing about vulcanization, that is, the time and the temperature required. Less often and more loosely, "cure" is used to mean the vulcanization agents like sulfur and accelerator.

Jargon has been used too long to be abandoned. It is too expressive to be frowned on and often is so concise that it is a great aid to readability or hearability. When used with understanding, its use may be encouraged. Examples of typical jargon are given and defined.

2:25 p.m.—3. The Literature of Natural Rubber. T. H. Messenger, Research Assn. of British Rubber Manufacturers, Shawbury, England.

This paper opens with a brief guide to sources of information relating to the early literature of natural rubber, including that concerning planting of rubber. Current literature is then surveyed by form and type. Supplementary selective bibliographies are appended.

The main part of the paper discusses the application of the literature to the needs of the rubber industry today. Notice is taken of the increasing volume of rubber papers now appearing in foreign languages, and a plea is made for the establishment of an effective cooperative arrangement, on an international scale, for the provision of a comprehensive translations service.

An analysis is presented of inquiries received at a rubber information center, and the types of literature appropriate to answering them are indicated. Since effective use of the literature depends on being able to find information as and when required, the necessity of an efficient system of classification of rubber information is emphasized.

2:55 p.m.—4. The Literature on Synthetic Rubber. Leora Straka, Goodyear Tire & Rubber Co., Akron, O.

The general subjects covered in this paper are research, manufacture, and technology of synthetic rubber. A bibliography is appended listing a number of the books which are sources of information along with the type of information included. The nature of the information contained in the various sources of periodical literature is also discussed.

Although government synthetic rubber reports are not available to the public at present, the types of information contained in the various classifications will be surveyed. Armed Services Technical Information Agency (A.S.T.I.A.) documents represent another form of government literature, which, although limited to government contractors, should not be neglected when the synthetic rubber literature is being searched.

Special publications of various technical societies such as The Rubber Manufacturers Association, Inc., ASTM, SAE, etc. will be considered. Other sources of synthetic rubber literature which will be covered include the PB reports, U. S. and foreign patents, and various company publications.

3:30 p.m.—5. The Rubber Division Library—An Experiment in Cooperation. Dorothy Hamlen, University of Akron, Akron.

The history, organization, purpose, and functions of the Rubber Division Library, with some specific examples of actual problems, are discussed.

3:45 p.m.—6. Classification Schemes for the Literature of Rubber. Lois W. Brock, General Tire & Rubber Co., Akron.

Of the classification schemes intended for arranging books on library shelves, the fourteenth edition of Dewey's "Decimal Classification" lists the single number, 678, for rubber. The fifteenth edition expands this, making use of eight major divisions under 678. The Library of Congress system, which is based on the large collection at the Congressional Library, uses notation involving letters of the alphabet and numerals to provide detailed coverage.

More extensive schemes for bibliographic classification include the Universal Decimal Classification and the Dawson Code. The fourth English edition of the UDC appeared in June, 1954, and is available in this country as British Standard BS 1000:678/679 (1954). It goes into much greater detail than the Dewey schedule on which it is based. Synthetic polymerization products, including rubber, are minutely subdivided by chemical type. The scheme of the Research Association of British Rubber Manufacturers, often called the Dawson Code, uses a series of letters and numbers for a thorough-going breakdown of information on rubber. A revised edition which appeared recently includes an abridged version for smaller collections.

4:05 p.m.—7. Reclaimed Rubber. A Guided Tour through the Literature. H. A. Winkelmann, Dryden Rubber Division, Chicago, Ill., and **J. M. Ball,**[1] Midwest Rubber Reclaiming Co., East St. Louis, Ill.

The earliest known bibliography was prepared by H. A. Winkelmann and E. G. Croakman, "Survey of Scrap and Reclaimed Rubber Literature," which covered the subject up to January 1, 1930. That bibliography has never been published. There is then a five-year gap before the first edition of the "Bibliography of Rubber Literature," in 1935. That bibliography, now published by the Division of Rubber Chemistry, ACS, is expected to be up-to-date, and on an annual basis, by 1958.

An attempt at a complete bibliography through 1955 is now being made under the direction of the authors, with the object of consolidating Winkelmann and Croakman's survey with the reclaimed rubber references in the "Bibliography of Rubber Literature." Dr. Winkelmann will fill in the five-year gap, 1930-1934.

The present paper consists of a list of general sources of information on reclaimed rubber, a résumé of important developments in the industry, a selected bibliography, and a glossary.

Wednesday Morning—September 19
Miss Friedenstein, Presiding

9:00 a.m.—8. Introductory Remarks. Miss Friedenstein.

9:05 a.m.—9. Rubber Compounding Information: Sources, Searching, Recording, and Retrieval. Kathleen S. Rostler, The Rubber Formulary, Bakersfield, Calif.

A brief survey is given of the sources of compounding information, with particular emphasis on the technical releases of chemical suppliers to the industry, which constitute the most important source of information on practical factory formulations.

Methods of finding and indexing this type of material are discussed. The difficulties in searching are explained by the fact that, in contrast to most technical literature searches, the material being sought is usually not references to a particular topic, but individual recipes which

[1]Name in bold face indicates person presenting the paper.

have been published in a number of widely scattered technical papers or releases.

Indexing methods which have been used to overcome these difficulties are discussed critically, and existing indices are described. The use of marginally punched cards for recording, filing, and finding individual published compounding formulations is discussed. The file card used in The Rubber Formulary for abstracting published literature is explained in detail as an example of using this type of filing system. Additional types of coding and indexing are suggested and explained.

The possibility of converting information gathered in a punched card file to tabular form in a permanent handbook, such as the now out-dated "Rubber, Physical and Chemical Properties," by T. R. Dawson and B. D. Porritt, is suggested.

9:40 a.m.—10. Patent Searching in the Field of Rubber Technology. T. A. O'Brien, Goodyear.

This paper discusses the following topics: the volume of material to be searched; objectives of the search; requirements of a patent classification system; how patents are classified in the U. S. Patent Office; the Classification Manual; the Index to Classification; Classification Bulletins; how these are used; constant revision of the U. S. Patent Office system of classification; foreign patents; distribution of rubber industry patents throughout the patent classification system; classification of patents relating to certain segments of industry, i.e., natural and synthetic rubber, tires, boots and shoes, rubber coatings; private collections of rubber patents.

10:05 a.m.—11. Standards and Specifications for Rubber and Rubber Products. J. J. Allen, Firestone Industrial Products Co., Akron.

This paper includes: (1) definitions of standards, specifications and recommended practices as used by the rubber industry; (2) sources of specifications in the rubber industry including technical societies, industrial technical committees and associations, Federal and Military bodies preparing specifications; (3) discussion of the make-up and scope of each of these groups and the type of specification issued by each; (4) an appendix showing the main specification-issuing bodies in this country together with the address and source of the various specifications issued by them.

10:25 a.m.—12. Government Reports on Rubber. P. S. Greer, National Science Foundation, and James Kanegis, Office of Technical Services, Washington, D. C.

There is no single index to unclassified government publications on rubber. The largest catalogued group covering the years since World War II is in the PB collection of the Office of Technical Services, Department of Commerce. OTS distributes printed copies; while the Library of Congress handles orders for unprinted copies. Both LC and OTS also service some 3,600 unclassified reports of the Office of Synthetic Rubber (and its predecessor organizations) which operated the government synthetic rubber plants.

The Government Printing Office prints, catalogs, and distributes many agency reports on rubber; publicity is through its Monthly Catalog and indices. Overlapping with OTS is negligible. Most government agencies will service individual inquiries, whether covered by existing reports or not. Nevertheless a comprehensive search should be conducted personally with the guidance of agency personnel. A knowledge of government organization helps considerably; this is obtainable through suitable guides.

Other agencies furnishing some reports on rubber include the following: Atomic Energy Commission, National Bureau of Standards, Bureau of the Census, Business and Defense Services Administration, Tariff Commission, and various segments of the Departments of Labor, Agriculture, and Defense.

Classified data and reports involve a different approach; their availability is determined through suitable clearances. The Armed Services Technical Information Agency is an important source here.

10:50 a.m.—13. Sources of Market Information on Rubber, Rubber Raw Materials, and Rubber Products. H. N. Stevens, B. F. Goodrich Research Center, Brecksville, O.

As background information for rubber industry market research, studies of attempts by the British to restrict crude rubber production and by the Germans to control synthetic rubber supplies are mentioned. Sources are given for statistics on crude rubber production, prices, and trade. Sources are given for statistics on raw materials for making synthetic rubber, including butadiene, styrene, isobutylene and acrylonitrile, synthetic rubber production, synthetic rubber prices, and synthetic rubber trade. Sources of reclaimed rubber production, prices, and trade are given.

The literature on current consumption of all types of rubber is reviewed together with various projections of consumption until 1975. End-use data are given for all kinds of rubbers in major consuming countries, and reference is made to the most complete recent U. S. studies on the amounts of various rubbers used in different rubber products. Sources of general economic statistics on the rubber industry are discussed. Alternate sources of identical statistics are given for the benefit of libraries with limited collections.

11:10 a.m.—14. New Publication Plans of the Division of Rubber Chemistry. Norman Bekkedahl, NBS; **R. G. Seaman,** RUBBER WORLD, New York, N. Y.; and David Craig, Goodrich Research Center.

Courses in rubber technology presented in recent years by the local rubber groups sponsored by the Division of Rubber Chemistry are being supplied to the New Publications Committee of the Division. An Editorial Committee will select the best lecture on each of the several subjects and will furnish copies of these lectures to the chairman of each local rubber group educational committee. The Division will publish a compilation of the selected lectures as an elementary textbook of rubber technology.

The Division is considering the publication of a fifth annual volume of its journal, *Rubber Chemistry and Technology*, for the purpose of presenting specially prepared and up-to-date reviews of important subjects in the literature of rubber chemistry and technology, patterned after *Chemical Reviews*.

Instead of a revision of the monograph "Chemistry and Technology of Rubber," by Davis and Blake, a series of short monographs to fill certain gaps in the literature of rubber chemistry and technology will be prepared. It is hoped that the first such monograph will be published in less than two years. In effect, the publication of these short monographs will result in a revision of the 1937 Davis and Blake monograph, but on the installment plan.

11:30 a.m.—15. How Rubber Literature Is Created: Preparing the Technical Paper. M. E. Lerner, *Rubber Age*, New York.

Technical papers form the heart and soul of the technical literature, and any errors which occur in the original manuscripts may be carried through the literature for all time. Accordingly, if a few relatively simple rules are followed by the authors in their original presentations, entire industries benefit. These rules are outlined and discussed. Suggestions for greater cooperation between author and editor are made, all designed to result in better technical papers, from the standpoint of both technical content and presentation. Some reference is also made to the problems faced by publishers in selecting the better types of papers and in avoiding duplication of materials.

Tlargi Holds Annual Outing

The annual outing of The Los Angeles Rubber Group, Inc., was held at the Hotel del Coronado, Coronado, Calif., June 9 and 10, with 275 members and guests in attendance. After an afternoon of athletic tournaments, the Group went to Mexico to watch jai-alai and other entertainment.

In golf, Don Montgomery, Xylos Rubber Co., achieved lowest gross; while Jim Keefe, Southwestern Rubber Co., copped low net honors. Blind bogey winners were Warren Steinmetz, Shell Chemical Corp.; Milt Churchill, Naugatuck Chemical Division; and L. Hawkins, a guest.

A water polo game was won by a team consisting of Don O'Connell and John Ryan, both of Shell Chemical; Milt Churchill; J. Martinson, Union Carbide & Carbon; and Ed Lynch, H. M. Royal, Inc. The versatile Mr. Lynch also captained the winning baseball team.

Other contests winners included Hal Waffle, Griffith Rubber Mills, guessing; Harold Brandenburg, Firestone Tire & Rubber Co., pitch and putt; Roger Reid and Floyd Price, both of W. J. Voit Rubber Corp., ping-pong; John McSparran, Durethene Corp., darts; Neil Pestal, Firestone, baseball toss; Tom Abbate, Zellerbach Paper Co., croquet.

Also Walter Gobson, a guest, shuffleboard; Bernie Hodowski, Firestone, and John Arensmeyer, Ratliff Rubber Co., tennis; John Adams, United States Rubber Co., horseshoes; Harry Salter, Voit, fishing; Don O'Connell, Shell Chemical, swimming; and Bill Fairclough, Naugatuck, bridge.

Door prizes were also won by 25 members and guests present at the outing.

RMA Molded & Extruded Subdivision Announces Educational Program

The annual meeting of the Molded, Extruded, Lathe Cut & Chemically Blown Sponge Rubber Subdivision of the Mechanical Division of The Rubber Manufacturers Association, Inc., was held at the Homestead, Hot Springs, Va., June 28-30. Eight papers were presented in a diversified program, three of which dealt with synthetic elastomers, one with natural rubber, one with the Defense Department's Production Allocation Program, two on cost education and the need of a cooperative educational program on fabrication methods and standards, and one on salesmanship.

Pierce Sperry, Sperry Rubber & Plastics Co., chairman of the subdivision, presided and was assisted by J. J. Catterall, secretary of the Mechanical Goods Division. Mr. Sperry thanked the membership committee and the executive committee of the subdivision for their help in preparing for the meeting and paid special tribute to Mr. Catterall in this connection.

The complete program for the meeting included the annual dinner on the evening of June 29 and the golf tournament on June 30. The major prize for the golf tournament was the Jim Bowman Trophy, donated by the Williams-Bowman Rubber Co., in the form of a beautiful sterling silver tray. Each year's winner will have his name engraved on the tray each year and will retain possession of the tray for the following year.

The Jim Bowman Trophy was won this year by Robert Sullivan, Jr., Lavelle Rubber Co. Second honors went to Howard Dodge, General Tire & Rubber Co., with low gross to Roger Smith, son of Howard Smith, Pawling Rubber Co., and second low gross to L. M. Johnson, Geauga Industries. The winner in the women's tournament was Mrs. Edith Smith. Mr. Johnson was in charge of the golf tournament.

Coral Rubber

The first paper on the program was given by Glen Alliger, Firestone Tire & Rubber Co., was entitled, "Properties and Applications of Coral Rubber—A *Cis* 1,4 Polyisoprene," and described the properties which make this rubber equivalent to natural rubber.

Since this paper was also presented before the Rubber & Plastics Division of the American Society of Mechanical Engineers and elsewhere in the recent past, and more particularly since it was published in the July issue of RUBBER WORLD, no further details will be given here.

"The Collapse of Time"

J. Lewis Powell, a key civilian on the staff of the Assistant Secretary of Defense (Supply and Logistics), discussed "The Collapse of Time—Industry's Role in Military Preparedness." Mr. Powell first explained how war has gone technological and where technology went during the same time. As one example, he pointed out that in 1910, airplane speed was 42 miles an hour. In 1945, top speed was 470 miles an hour for military aircraft, and 10 years later a speed of 1,600 miles had been achieved. The curve of progress in this field therefore shows no progress for centuries, then more and more progress each year until the super-accelerated progress of a single year exceeds that of previous centuries.

This curve has been called "The Collapse of Time," he said. Time is no longer the major ingredient in progress. You can forget that we plotted this curve for speed, and you can substitute missiles, explosives, or medicine. The results are always the same, he added.

Direct defense requirements for any future war in which this country is involved and including guns, planes, ships, missiles, etc., that are used directly by the Army, Navy, and Air Force are dependent on the Production Allocation Program of the Department of Defense. This program matches specific potential military customers to individual potential producers and is a basic step in mobilization planning. The military and industry sit down together and do across-the-table planning in peacetime in order that the buyer and seller discover each other now, and in event of war, hide-and-seek would be eliminated, the mobilization impact would be spread more evenly across our capacity, and better utilization of each plant would be achieved because management had a chance to plan the use of its plant in advance.

This planning is with prime contractors only who fabricate items whose end-uses include survival and retaliation, increased combat efficiency, and maintenance of health, it was emphasized.

It is important for industry to understand who and what an Armed Services Procurement Planning Officer, or ASPPO, and the Register of Planned Mobilization Producers are. The ASPPO officer represents all of the Armed Forces and acts for the Assistant Secretary of Defense in coordinating all the military planning with a given plant or company. He negotiates tentative mobilization production schedules (DD Form 406), working with a plant or company representative to balance military production against production capacity for each plant.

The Register of Planned Mobilization Producers lists the 24,000 plants with which the Defense Department is planning, and it cross-references each plant listed to the military departments planning with it. Although the Register is a classified document, every manufacturer is entitled to see his own entry, or to be told he is not registered.

We are faced with the possibilities of the long war, the short war, the quick war, and the slow war, and modern weapons do not give time for obsolete thinking; we must outsmart potential enemies by unleashing our fettered imaginations, the speaker pointed out.

In conclusion, Mr. Powell made a plea for the use of the brains, initiative, imagination and know-how of the industry executives in the audience as "Vice Presidents in Charge of Tomorrow" to store in the Arsenal of Democracy.

Butyl Rubber Qualities and Usefulness

J. L. Ernst, Enjay Laboratories, presented a paper on "The Qualities and Usefulness of Butyl Rubber," in which he first stated that this rubber is produced in two plants in the United States and one in Canada for which the total annual capacity is more than 116,000 long tons a year. Construction of two additional plants is under consideration in the United States and one in France, which would raise the world capacity to 175,000 long tons annually.

The basic structure and properties of butyl rubber were first described and the several Enjay Butyl grades detailed. The advantages of butyl rubber over natural and styrene-butadiene (SBR) rubbers were explained. The ability of butyl rubber to maintain high tear resistance on aging or exposure to high temperature is of considerable importance in belting, hose, and pads which are stapled or otherwise fastened to metal, as well as to mechanical goods in general.

Compounding techniques for obtaining maximum resistance to heat and age resistance, resistance to ozone, chemical and solvent resistance, and resilience were described in some detail.

A major use of butyl rubber has been in power cable where installations carrying as much as 22 KV have been made. Some of the future conveyor belt installations for transporting people will be made with butyl belts. It has been shown that tires can be produced from butyl rubber that have the advantage of improved riding comfort, no squealing on turns, and greater resistance to tread groove and sidewall cracking. Final development testing of butyl tires is currently under way, the speaker said.

In conclusion, it was emphasized that non-transport uses of butyl rubber have grown from 5% to 15% of the total since 1947, and that the future should see many new applications for this rubber. In addition, there will undoubtedly be new polymer modifications, accelerators, curing systems, and even fillers in the near future to aid the growth of the use of butyl rubber in both transportation and non-transportation products.

Cost Education Program

C. W. Halligan, treasurer of the RMA and head of its statistical and accounting committees, presented a report, "Analytical Study of the Cost Educational Program," which resulted from a survey of cost accounting methods used in the molded and extruded branch of the industry and was described at last year's meeting.[1] A second survey was made beginning last fall in which 28 companies participated, and the results of this survey were discussed at a meeting in Cleveland, O., February 2, 1956.

At the above-mentioned meeting of February of this year similar wide differences in the cost of several molded, extruded, and sponge rubber parts were reported, as had been the case in 1955. Some examples of these differences are listed in Table 1.

[1] RUBBER WORLD, Aug., 1955, p. 621.

TABLE 1. RUBBER PRODUCT COSTS AS CALCULATED BY DIFFERENT COMPANIES

Part No. and Type	Low Cost	High Cost
7—Simple extrusion	$104.74/1000 pcs.	$186.23/1000 pcs.
8—Complex extrusion	36.57/1000 ft.	65.02/1000 ft.
9—Simple molded to metal	38.51/1000 pcs.	118.38/1000 pcs.
10—Complex molded to metal	248.45/1000 pcs.	467.94/1000 pcs.
11—All rubber molded	69.02/1000 pcs.	203.19/1000 pcs.
12—Chemically blown sponge rubber	109.22/1000 pcs.	194.42/1000 pcs.

The reasons for the wide disparity in costs between companies were not due to clerical errors or accounting, but differences in the interpretation of the drawings and specifications or in the judgment exercised by those interpreting the prints and specifications as to what manufacturing methods would meet the requirements stated in the specifications, it was said.

Specially appointed small subcommittees were designated to study in minute detail the figures and information submitted for the above survey, and these subcommittees met again in Cleveland on April 18. The chairmen of these subcommittees were as follows: Pierce Sperry, for extruded goods; S. A. Edgell, Ohio Rubber Co., for molded to metal parts; and W. J. Gurtner of General Tire & Rubber Co., for simple molded rubber parts.

The final reports of these subcommittees were then summarized as follows:

(1) Many companies submitted costs on types of goods they do not regularly manufacture and, in many cases, are not equipped to produce competitively, and their lack of knowledge was obvious in the figures submitted.

(2) With the companies regularly producing the types of products under consideration, the greatest reasons for cost differences were not due to accounting technique but to errors in judgment in reading the prints and specifications as to customer requirements.

(3) Even after it was decided which quality compound would meet the specification, the accuracy of computation of the volume of the finished piece, although reasonably accurate, in many cases ignored small irregularities in the part.

(4) With molded to metal parts, even when the metal part was supplied by the customer, costs incurred in receiving and handling such metal parts were ignored by many companies.

(5) Also, with molded to metal parts, there was a decided variation in the type of adhesion (mechanical or chemical) used for a given end-product which was reflected in the final cost.

(6) Decision as to the type of packaging used to insure satisfactory delivery to the customer often resulted in large differences in cost between companies.

(7) Considerable variation in direct labor costs resulted from differences in opinion as to the degree of finish and inspection required for a given item. Many companies use average pound costs for finishing; while others base cleaning costs, as they should, on the job done on each product. There is a need of standard definitions for types of finishing for molded goods now known as "flash free" or "die trim," etc.

(8) In connection with factory overhead, on any operation where the man-hours and the machine-hours do not correspond on all products made in a given cost center, the machine-hour figure should be used.

(9) The waste loss element of cost is important enough to require specific waste loss factors for each type of product instead of averages for large groups of products.

In summary, it was said that there was an urgent need of a common terminology for use in connection with interpreting customers' prints and specifications, better judgment in determining how to meet a customer's requirements, and greater care in estimating costs for each product, with a reduction in the use of general average cost figures.

Cooperative Educational Program

H. C. Dinmore, Tyer Rubber Co., next discussed the "Cooperative Education Program," which was apparently required as a result of the findings of the "Cost Educational Program," mentioned above. The committee for this program is headed by Mr. Dinmore and includes C. L. Shreiner, Chardon Rubber Co.; W. S. Daley, Sponge Rubber Products Division, B. F. Goodrich Co.; K. N. Carter, Ohio Rubber Co.; Pierce Sperry; H. M. Dyer, Acushnet Process Co.; J. F. Dunnigan, H. O. Canfield Co.; and J. J. Catterall. The ultimate objective of this committee is to publish a brochure which would explain adequately the characteristics of the products of the molded, extruded, lathe cut and chemically blown sponge rubber products group and set up standards of performance.

Working committees of technical personnel best qualified to consider these matters have been appointed and are now functioning with the following men as chairmen: molded goods and rubber to metal parts, John Gerstermaier, Goodyear Tire & Rubber Co.; extruded goods, Mr. Shreiner; sponge rubber products, G. R. Sprague, Goodrich; and lathe cut goods, H. W. Osborn, Stalwart Rubber Co.

It was pointed out that the real benefits of the program will appear when it is made available to the customers, and that the standards must be acceptable both to the manufacturers and their customers. In the hands of the customers' design engineers the information should be as valuable as material specification charts of the American Society for Testing Materials; in the hands of the customers' quality control men it should result in a clearer understanding of the quality levels to be expected; and in the customers' purchasing department it should mean easier evaluation of quotations and less chances for disagreement on features and quality.

It is expected that the work involved will be completed in time for a report at the next annual meeting of the Subdivision.

Future of Elastomers

A. C. Stevenson, elastomers division, Du Pont, presented a paper, "A Look into the Future of Elastomers," in which he discussed the general-purpose natural and styrene-butadiene rubbers, the several specialty elastomers, and the new elastomers, vinylpyridine-butadiene copolymer and urethane rubber.

The future of natural rubber is very probably going to be influenced by the new synthetic polyisoprenes which should have a stabilizing effect on the price of natural rubber and thus remove one of the uncertainties associated with the use of natural rubber, Dr. Stevenson said.

Minor modifications of the general-purpose styrene-butadiene rubbers (SBR) will be developed which will lead to improved properties and processing characteristics, and there is little apparent today that challenges the immediate future of this workhorse of the synthetic rubbers.

The recently announced development of *cis*-1,4 polybutadiene by Phillips Petroleum Co. should be a low-cost product, and although it is too early to predict the potential of such a development, it should be watched closely, Stevenson also said.

With regard to the established specialty rubbers, the emphasis with the Thiokol polysulfide rubber is expected to shift to the fluid Thiokols in the future since these products are showing a proportionately greater growth than the solid Thiokols.

The basic low-price structure of butyl rubber will almost certainly serve as a powerful incentive for future technical advancements, it was said. Mention was made of the brominated butyl rubber developed by the B. F. Goodrich Chemical Co. as an indication of the trend to provide improved vulcanization systems for easier processing and improved physical properties.

Dr. Stevenson reported that Du Pont is currently examining the merit of semi-fluid neoprene which can be cured at room temperature and which should simplify the preparation and application of neoprene compounds for caulking materials, sealants, gasketing, and certain molded products, or might be used as a plasticizer for other types of neoprene.

Du Pont is also experimenting with neoprene in a finely divided or powder form which would simplify cement preparation and also might be compounded by tumbling in the dry form.

Stephen Blake

Pierce Sperry, Subdivision chairman, who presided

It was emphasized that these new neoprene developments were still in the laboratory stage.

Hycar 1072, a nitrile polymer with a small amount of carboxylic acid function in the chain, was mentioned as a unique synthetic of this type for which tensile strengths of 11,000 psi. have been reported. The "oil" resistant elastomer of the future is quite apt to be a basically new type of material; however, because of the demand for elastomers with a combination of high temperature and oil resistant properties, Dr. Stevenson suggested. This does not mean that nitriles will not occupy an important place in the future, for which they are fully adequate for numerous applications in which they are now serving, he added.

Du Pont's "Hypalon," or chlorosulfonated polyethylene, was next mentioned, and its general good aging properties, and resistance to heat, abrasion, and chemicals were described as qualifying it for a variety of uses including white sidewalls, weatherstripping, floor tile, and wire insulation for high-temperature service.

The acrylic elastomers and the new Vyram polyacrylic polymer of Monsanto Chemical Co. were discussed, with the Vyram described as a specialty elastomer for specific use, e.g., resistance to swelling in oils and hydraulic fluids at temperatures of 212° F.

The new vinyl substituted silicone rubber with improved curing characteristics of Union Carbide & Carbon Corp. was mentioned as an example of the development trend for this-type rubber. Improved aging at 600° F. and improved resistance to ASTM No. 1 oil, as compared to dimethyl silicone rubbers, were cited as evidence of a real step forward in the field of silicone rubber development.

There are many indications pointing to an important future for the fluorine containing elastomers such as Kel-F, of M. W. Kellogg Co., and Poly FBA, or 3M Brand Fluororubber 1F4, of Minnesota Mining & Mfg. Co., it was said.

The new elastomer, 2-methyl-5-vinylpyridine butadiene or Philprene VP, of Phillips Chemical Co., now that a less scorchy curing system has been devised, should have increased use as a tire tread rubber because of indicated high abrasion resistance and excellent hysteresis properties.

Urethane rubbers will eventually represent a substantial volume in the synthetic rubber market because of their outstanding strength, abrasion, solvent, ozone, and age resistance. Du Pont's Adiprene B is unique in that it is reinforced with carbon black; while other urethane rubbers are not. Although processing of these rubbers is difficult, recent research and development work has resulted in modifications of the urethane rubber which permits the use of conventional elastomeric curing systems.

Du Pont is investigating the possibility of fluid urethane polymers, and a new processing and mixing system for such polymers was illustrated which offers a new manufacturing approach for the rubber goods manufacturer.

Dr. Stevenson concluded his talk with the observations that 10 or 15 years from now some of the new elastomers mentioned will have fallen by the wayside, but some of them will have developed to full stature in this field of elastomers.

Natural Rubber Supply and Quality

W. J. Sears, RMA vice president and chairman of the Association's crude rubber committee, spoke next on "The Outlook for Natural Rubber Supply and Quality." He first emphasized that the United States now uses only one-third of the world's natural rubber, compared to more than one-half 20 years ago. He also emphasized that world natural rubber production during the last five years has varied only slightly from year to year, and that no further increase in production is expected until 1960.

Meanwhile, total worldwide natural and synthetic rubber consumption is expected to increase by at least 600,000 long tons by 1960, and obviously this increase will have to be taken care of by synthetic rubber. The United States uses about 60% synthetic rubber at the present time, and it may prove technically difficult to increase this percentage of the total above 65. Outside this country, the percentage of total new rubber used is at present only 12, but is expected to increase to 30 by 1960.

The most important factor in the continued growth of synthetic rubber consumption abroad is the competitive price of natural rubber, and if foreign consumers do not increasingly convert to synthetic rubber, they will demand increased supplies of natural rubber. Such a situation would bring foreign consumers into competition with consumers in this country for available supplies of natural rubber and might mean a further inflation in natural rubber prices.

It was explained that the reason the natural rubber producers would be unable to increase their production in the near future was about half of the world's natural rubber comes from a disorganized group of hundreds of thousands of smallholders, and there has been very little replanting of high-yielding rubber trees among these smallholders. Although the prospects of increased production from the well-organized estate producers that account for the remainder of natural rubber production are better, these estate owners since World War II have been faced with many difficult problems of finance, taxation, security, political climate, labor, and land tenure.

The potentials of replanting were illustrated by the example of a 10,000-acre estate now producing 500 pounds per acre per year, or 2,232 long tons for the estate. The same acreage, if replanted with high-yielding stock, could in seven years' time yield 8,928 long tons a year. Since about 60% of natural rubber costs are in tapping labor, productivity per tapper could be increased four times, and under such circumstances the per-pound cost of natural rubber could be reduced to a figure far below any foreseeable minimum cost of any type of synthetic rubber, it was added.

In connection with rubber quality, it was also explained that concentrated latices, air-dried sheets, Nos. 1, 2, and 3 smoked sheets, and pale crepes and estate brown crepes are made on the estates. The lower grades of rubber, such as #4 and #5 RSS, thin browns, ambers, and flat bark

Stephen Blake

Left to right: W. J. Sears, who discussed natural rubber; J. L. Ernst, butyl rubber; Glen Alliger, Coral rubber; and A. C. Stevenson, new elastomers

Stephen Blake

Left to right: C. W. Halligan, who discussed the cost education program; J. Lewis Powell, industry mobilization; J. H. Caldwell, locating markets; and H. C. Dinmore, cooperative educational program

are made from rubber produced by smallholders. Although the demand for the lower grades has grown in recent years, any increased supply is likely to come in the higher grades.

Natural rubber, with the exception of concentrated latices and a few minor exceptions, is not produced to technical standards in the same way as synthetic rubber. Natural rubber is graded by visual means and classified into its proper grade. During the past two years, the RMA has been actively engaged, together with many other rubber organizations throughout the world, in an effort to reconcile differences of opinion between producing and consuming countries as to the proper standard for certain of the rubber grades. A draft publication entitled, "Type Descriptions and Packing Specifications for Natural Rubber Grades Used in International Trade," was sent on June 1, 1956, to 31 rubber organizations in 13 different countries asking for their support and endorsement. It is hoped to publish the final version of these descriptions and specifications before the end of 1956.

For the first time in the history of the rubber industry there will then be available in one publication standards and specifications endorsed by all of the principal rubber organizations of the world. It is hoped that through these means natural rubber quality will improve, and that rubber buyers throughout the world will have greater confidence in obtaining the type of rubber they have purchased, Mr. Sears said in conclusion.

How to Locate Markets

The final talk was given by John H. Caldwell, managing editor, *Sales Management*, another Bill Brothers publication, and was on the subject of "How to Locate Your Best Markets." Since the members of the RMA Subdivision present were fully aware of their obvious markets, Mr. Caldwell mentioned some markets which might represent new prospects. They were as follows:

1. The 383 corporations which are growing at a rate faster than the national average. The list of these firms was compiled by Arnold Bernhard & Co. and published in the March 15, 1956, issue of *Sales Management*.

2. The 100 corporations, as compiled by Lionel E. Edie, management consultant, New York, which spend 10% of their income on product research and who subsequently enjoy a greater than average growth in the market place.

3. *Sales Management*'s "Survey of Buying Power," which estimates employment for 20 industries involving the 100 most important counties in each industry.

4. *Fortune* magazine's directory of the 500 largest United States industrial corporations which account for one-half of the nation's output.

Mr. Caldwell then asked the Subdivision members if they were sure they *could not* build a brand name for certain of their products which would give them an edge in the dead-heat race on price, delivery, performance, and reciprocity, that most of the companies run with each other as competitors. He also asked if each company had enough salesmen, and if the salesmen make calls on enough people within the plants of present customers.

In conclusion, it was emphasized that all companies and all industries *must* succeed in finding their best markets because: we have more people to care for and more jobs to provide; the general public expects businessmen to avoid economic busts; we must do our part to make capitalism more attractive than communism; and, finally, it is up to us as individuals to do all we can to insure our national safety and prestige.

Slate Atom Energy Confab

The National Industrial Conference Board's Fifth Conference on Atomic Energy in Industry will be held in Philadelphia, Pa. March 14 and 15, 1957, at the Benjamin Franklin Hotel and Convention Hall, it has been announced by John S. Sinclair, president of the Board.

The conference will coincide with the Second Nuclear Engineering & Science Congress of the Engineers Joint Council to be held at Convention Hall, March 11-15. The Congress will include the Annual Atomic Exposition of the American Institute of Chemical Engineers. A hot laboratory conference on problems of handling radioactive materials will be part of the week's activities.

More than 5,000 business executives, engineers, scientists, and government officials from the United States and other countries are expected to attend the combined conferences, and more than 15,000 are expected to visit the Atomic Exposition, at which the latest developments in the applications of nuclear energy will be displayed.

The Conference on Atomic Energy will also feature addresses by spokesmen for the atomic energy field, both here and abroad, and 12 round-table discussions in Convention Hall on such topics as recent developments in radiation chemistry and radioisotopes applications, foreign and domestic markets for atomic energy products, as well as the economics of new reactor types.

Northern California Talks

The Northern California Rubber Group, meeting at the Elks Club, Berkeley, Calif., June 14, heard technical addresses by John Eynck and Robert Ford, both of the rubber laboratory at Mare Island Naval Shipyard, Vallejo, Calif. Fifty-five members were in attendance.

Mr. Eynck discussed the present status of knowledge on ozone deterioration of various rubber compounds. He covered the theory of ozone attack, possible mechanisms of antiozonants, and compared the efficiencies of several polymers with respect to aging in an ozone-containing atmosphere.

Mr. Ford described tests which had been made on sandblast hose to determine the relation between the electrical resistance of the hose and the static electricity generated by the hose. These properties varied with the compounds used.

Connecticut Rubber Group Holds Reclaimed Rubber Symposium

The annual spring meeting of the Connecticut Rubber Group held at the Actor's Colony Inn, Seymour, Conn., May 25, was in the form of a symposium on reclaimed rubber. Group Chairman James Boyle, Armstrong Rubber Co., introduced the moderator of the panel Thomas Fitzgerald, Naugatuck Chemical Division, United States Rubber Co., and the moderator then introduced the panel members, who were as follows: H. D. Glenn, Naugatuck Chemical; F. E. Traflet, Pequanoc Rubber Co., who substituted for C. F. Hoover, of the same company; John Ball, Midwest Rubber Reclaiming Co.; William Boyd, Xylos Rubber Co.; E. B. Busenberg, The B. F. Goodrich Co.; and Croft Huddleston, U. S. Rubber Reclaiming Co., Inc.

It was reported that attendance at this meeting was the best ever achieved for a spring meeting. The Group voted to increase the yearly dues of its members to $2 a year.

The questions and the answers presented at this symposium are given below in the order of their presentation:

Q. What is reclaim?

A. Ball. Reclaimed rubber is the product resulting from the treatment of ground vulcanized scrap rubber tires, tubes, and miscellaneous waste rubber articles by the application of heat and chemical agents whereby a substantial "devulcanization" or regeneration of the rubber compound to its original plastic state is effected, thus permitting the product to be processed, compounded, and revulcanized.

Any fiber present in the scrap is removed either chemically or mechanically.

Reclaiming is essentially depolymerization; the combined sulfur is not removed. Indeed, it would probably be disadvantageous to remove this combined sulfur, even if it could be done commercially, because it is believed that many of the advantages of reclaim are connected with the presence of combined sulfur.

The product is sold for use as a raw material in the manufacture of rubber goods with or without admixture with natural or synthetic rubber.

First-quality whole-tire reclaim contains about 50% of rubber hydrocarbon by weight. The non-rubber component consists of valuable softeners, zinc oxide, antioxidant, and carbon black, all of which are substantially unchanged by the reclaim manufacturing operations and may be counted upon, therefore, to function essentially as virgin materials. Reclaim also speeds the cure of styrene-butadiene rubber (SBR) with freedom from scorchiness, and this accelerating value can be translated into definite cost savings.

Reclaimed rubber is a high-grade compounding ingredient, attractive in price, imparting excellent properties both to uncured and cured compounds. It is used not only to lower volume cost, but also to lower processing costs and to reduce seconds or defective goods.

You will sometimes hear it said that if first-quality whole-tire reclaim costs 10½¢ per pound and contains 50% rubber hydrocarbon, then the RHC of the reclaim costs 21¢ per pound. This fact would be true provided that the softeners, zinc oxide, antioxidant, and carbon black which comprise the non-rubber component are assumed to be worthless.

Actually, as pointed out earlier, these ingredients are essentially unchanged by the reclaiming operation and are therefore substantially as potent as if they were still virgin materials. Considering the delivered cost of these various ingredients, it is not unreasonable to assume a cost of 5¢ per pound for the entire non-rubber component.

If the RHC is 50% by weight of the total reclaim, its cost, then, is 21-5, or 16¢ a pound.

Q. How is reclaim manufactured? What methods are commonly employed?

A. Huddleston. The main volume of reclaim is made by four basic processes.

THE DIGESTER PROCESS. Since the advent of SBR into tire scrap, the bulk of our rubber source, the digester process has undergone quite a change. The digester process used alkali, but SBR acts differently from natural rubber in an alkali cook. Instead of becoming soft and plastic, as natural rubber does, SBR hardens, and you end up with a mass, or mess, something like sand and chewing gum.

The SBR separates out as tailings on the refiners, and since the percentage of SBR in today's scrap tire is almost 50/50 with natural rubber, smooth finished reclaim is a very small yield of the total. For this reason, in the 15 years since SBR synthetic rubber took its place in the rubber industry, the digester process has been converted to the use of so-called neutral materials such as zinc chloride and calcium chloride. These act as defiberizers in the same way as the sodium hydroxide and yield a reclaim which is as smooth as the old natural rubber one and is satisfactory for use in rubber compounds. The neutral reclaims tend to be a little stiffer and shorter, but the physical properties are equivalent.

The cracked rubber scrap is charged to the digester solution and subjected to a cook for some period of time. The devulcanized mass is blown down, washed, put through a series of dryers and worked on, or in, a massing device. The reclaim is strained and refined.

PAN PROCESS. The pan process has been in use almost since the birth of the vulcanization of rubber. The scrap rubber is ground up and put into a pan, with or without additional reclaiming agents, and is subjected to steam pressure. The pan cake is then removed, passed through a breaker, and worked on, or in, massing devices, and then refined until it is a smooth reclaim. Today the scraps subjected to the pan process are not limited, as they were in the past, to fabric-free scraps. Whole-tire scrap could be reclaimed in the pan, but the fiber had to be included in the finished reclaim.

Now, by using the air separation method, fiber can be removed from the scrap rubber by mechanical means. The tires are cracked and reduced in size until the fiber is entirely separated by the dry air. The separated rubber is ground to a 30- or 40-mesh size and pan reclaimed.

Reclaims using the finely ground rubber accentuate the excellent properties and characteristics of pan reclaims. Pan reclaims will always have a very definite place in the reclaiming industry.

THE RECLAIMATOR PROCESS. The 30- or 40-mesh ground rubber from the air separation process is mixed with reclaiming agents and passed through an extrusion-type machine, where it is subjected to heat and pressure. The subsequent reclaim is extruded from a specially designed head and can be refined, extruded, or powdered. The Reclaimator Process can be varied in a great number of ways and is therefore the most versatile, as well as the only continuous, method of making reclaim. Reclaims made on the Reclaimator are, softer and more plastic than reclaims made by the other processes.

THE LANCASTER-BANBURY PROCESS. By using a specially built Banbury with close clearances and running it at high speed (45-50 rpm), cracked scrap can be made into reclaimed rubber. It is sometimes necessary to add load, to generate friction heat during the processing.

This is a batch process; the reclaims are shorter and drier than those made by the other three methods. The batch from the Banbury can be refined until smooth.

There have been other methods of manufacture of reclaimed rubber. Some are used on a small scale; while others have been forgotten, but as long as scrap is generated, there will always be a reclaimed rubber—and there will always be new ideas for making it.

Q. What types of reclaim are commercially available?

A. Busenberg. A very large percentage of the tonnage of reclaimed rubber produced today is based on scrap tires and inner tubes. Whole-tire reclaims may be based on passenger tires, truck tires, or a blend of the two. Truck tires are commonly cut up and split into tread and carcass portions by manufacturers of auto parts, such as shims, or by dealers or reclaimers. The tread portion is used to make high black tread or peel reclaim, useful in such products as camel back, heels, soles, belt covers.

The carcass portion of large-size truck tires is high in natural rubber hydrocarbon and may be reclaimed by the alkali or neutral process. Carcass reclaims are quite popular in adhesives and water dispersions. A limited amount of light-grey truck carcass scrap is still available from segregated split stock.

Natural-rubber inner-tube scrap is available to the reclaimer in black and red colors, with supply slowly diminishing. Butyl inner-tube reclaim is a popular and very interesting product.

Miscellaneous scrap such as curing bags, and mechanical scraps, if available in sufficient flow, are reclaimed as such or incorporated in blends for specific purposes.

There is always demand for light-colored reclaims if adequate supply of scrap can

be developed at prices which facilitate successful competition. Such scraps as thread, foam sponge scrap, and light-colored soling are reclaimed.

These basic reclaims are modified by the reclaimer with additives which may have very profound effects on texture and properties of reclaims for specialized uses. For this reason the number of grades in a reclaimer's line of products will fan out to 50 or 100 grades if no control is exercised. From the viewpoint of production, cost of clean-ups, maintenance of warehouse stocks, etc., this trend is somewhat undesirable and costly to reclaimer and customer.

The slow trend to automation in batch compounding methods has created some demand for reclaim in powdered or pelletized particulate form.

Sizable tonnages of premixes are now being made. Here the reclaiming plant adds sizable additions of compounding ingredients which are dispersed into the reclaim through the refining operations.

Q. How is reclaim used in transportation items?

A. Boyd. One hundred sixty-seven thousand six hundred and eighty (167,680) long tons of reclaimed rubber, more than half the reclaimed rubber produced, were used in the transportation segment of the rubber industry in 1955 because reclaimed rubber is an important source of rubber hydrocarbon at a lower cost than other sources of rubber hydrocarbon.

The largest use of reclaimed rubber, of course, is in tires. Most, if not all, first-line passenger tires produced by the major companies contain reclaim since it is possible to give the customer more miles per dollar by replacing new rubber with reclaimed rubber.

Properties of the various tire reclaims are dependent on the following factors: (1) type of scrap; (2) devulcanizing oils; (3) defiberizing agent; (4) methods of reclaiming; (5) pigments added to devulcanized scrap; and (6) smoothness.

Neutral whole-tire or modified whole-tire reclaims are consumed in the largest quantities, but other types are also used, such as tread reclaim commonly known as peeling reclaim; this latter is used in camelback bead stock and sidewall stock.

Another special type of reclaim is known as non-staining type. It is used in the manufacture of white sidewall tires as well as many other mechanical goods products, such as steering wheels and automobile floor mats. Such a reclaim is made from selected tire scrap devulcanized with oils that do not stain. Some non-staining reclaims contain pigments which further reduce the staining of the reclaim.

There, of course, are wide differences in processes at the various reclaiming plants, but all changes and any new reclaims developed are thoroughly tested in the laboratory before being released. In addition to this testing, indoor tire tests as well as fleet tests are run on tires which contain new or modified reclaim.

Indoor tire tests usually show: (1) crown break; (2) tread separation; (3) radial cracking; (4) running temperature; (5) failing speed.

Fleet tests generally show: (1) tread wear; (2) tread cracking; (3) any construction defects; (4) tread separation; (5) tire growth; (6) running temperature; (7) ply separation; (8) weathering; (9) radial cracking.

Reclaimed rubber is used in many first-line tires because of a lower cost without any corresponding drop in quality.

Second- and third-line tires usually contain larger quantities of reclaimed rubber. The inherent advantage of reclaimed rubber such as good aging, lower power consumption, rapid breakdown, faster extrusion speeds, shorter Banbury mixing cycle and uniformity may not be so important to the tire manufacturer as they are to a manufacturer of high-reclaim content products such as mats, battery boxes, semi-pneumatic tires, etc. Nevertheless the stable price and supply of reclaimed rubber mean that it will always be an ingredient of tires.

Most butyl tubes contain butyl reclaim, which is used both for cost reduction and improved processing. This application is now only a small consumer of reclaimed rubber.

Butyl reclaim is used in many automotive mechanical goods applications; considerable quantities are used in radiator hose and extruded gaskets.

Other reclaims, whole-tire, modified whole-tire, specialty reclaims are being used in large quantities in floor mats, "Throw In" mats, semi-pneumatic tires, and battery boxes.

The reclaimed rubber industry is of vital importance to the automotive industry because it has been uniformly low in cost from year to year. From 1949 to 1956, the pound cost of whole-tire reclaim varied between 8¢ and 10½¢.

Q. What are the advantages of reclaimed rubber when used in such items as heels and soles and friction tape?

A. Traflet-Hoover. Non-automotive items such as friction tape, insulated wire, semi-pneumatic tires, soles and heels account for approximately 9.5% of the total reclaim consumed.

Reclaims for friction tape differ from those normally produced in elastomer type, and tackiness. Natural rubber automotive tires and tubes are most generally used as the basic scrap, with special oil and resin formulations, followed by a heat treatment. Recent developments on friction-tape compounds have included an evaluation of butyl reclaim as an additive to natural tube and tire stocks to improve aging characteristics. The retention of tack over prolonged shelf aging is a necessity; therefore, proper selection of reclaiming oils and resins is a critical factor. Probably in no other field are there greater differences in compounding practices than those for friction tape. Combinations of elastomer, reclaims, and resins are constantly being evaluated in this item.

For a number of years the insulated wire field used large quantities of so-called natural base tire and boot and shoe reclaims. These types were particularly advantageous once the fiber was removed, and the material heat-treated with the necessary oils, then well refined. The filler present contributed to smoothness of the finished material.

Fiber was removed by the acid process, and the neutralized, washed ground rubber was subjected to the necessary oils with a heat treatment. The preliminary treatment, before mixing with oils and subjection to temperatures in excess of 350° F., proved more effective in removing the objectionable fiber and other foreign material than is possible on soft tacky reclaimed particles. This procedure was followed by careful refining to produce an extremely smooth sheet. Subsequent compounding of this reclaim with some new rubber produced compounds that were fast extruding and fast curing, with excellent electrical properties.

The introduction of plastics and the trend to thinner insulations, with competitive pricing, has had an adverse effect on the use of reclaim in the insulated wire field. Present usage is restricted to heavier-gage code, automotive, and tinsel wire.

The manufacture of semi-pneumatic or low-pressure tires for materials handling and lawn-mower wheels is becoming highly competitive, and to introduce economies in material and processing costs, reclaim is being utilized. Requirements include freedom from nerve, added tackiness for splicing, and smooth extrusion. Abrasion resistance is also a prerequisite, and reclaims containing relatively high percentages of carbon black are applicable. Peel and modified whole-tire reclaims demonstrates types regularly employed.

Prior to World War II and the rubber crisis of that period, the largest percentage of soles and heels manufactured were black for maximum wear resistance. Civilian rubber soles and heels (with reservations on the term rubber) made during the war were allowed only the lowest-grade reclaims. These were further compounded with high ratios of black to improve wear resistance, and, as a consequence, severe marking problems were encountered. The housewife's resistance to the marking of her floors resulted in the production of non-marking or neutral soles and heels.

The amount of black reclaim used today in soles and heels is substantially lower and is of the peel grade, with some regular whole tire.

The lighter-colored reclaims produced from cellular soling, tan rigid soling reinforced with high styrene resin copolymers, as well as foam sponge and garment scrap, are receiving widespread acceptance in the sole and heel trade.

Q. Can you enlarge on what Mr. Hoover has told us, indicating the use of reclaim in such articles as garden hose, water dispersions, and solvent cements?

A. Glenn. Reclaim is a well-known ingredient in garden hose, belt friction and cover stocks, sheet packing, solvent cements, and water dispersions. Its primary importance, particularly for the first three items mentioned, is a combination of economics and improved processing.

Reclaim has been used for years in garden hose because it was an inexpensive source of rubber hydrocarbon. It also affords more uniform extrusion and thus faster extrusion rates, due to the reduced nerve reclaim imparts to hose compound. In addition, reclaim gives a raw stock with high modulus and good mechanical properties, both of which are advantageous to processing. Although use of reclaim in hose has given a lot of ground to vinyl

plastics, it is apparent that the future of rubber hose looks brighter because vinyl hose has certain limitations in colder climates. More reclaim will be used in garden hose in the future.

Reclaim also contributes to favorable economics in belt friction and cover stocks and in sheet packing. It aids in frictioning by helping wet the fabric, and its presence improves calendering. It is generally accepted that belts compounded without reclaim are more difficult to process. In cover stocks, the main purpose of reclaim is to take out nerve. In sheet packing, the incorporation of reclaim gives faster processing, and the stocks show less creep. There is also some evidence of less blistering when the right reclaim, properly aged, is used in sheet packing.

The use of reclaim in solvent cements is based on somewhat similar attributes. Although the reclaims used are generally the highest priced reclaims, they still present a cost advantage over new polymers used in cements such as neoprene, nitrile, and natural rubbers. Along this same line, lower-cost solvents can be used with reclaim cements. Further advantages for reclaim in solvent cements are evident in the excellent spray ability of such cements for industrial application, their high level of stability, excellent cohesive strength, and good tack on laid-out films. These cements also bond well to a wide variety of materials including metals, fabric, and wood.

In water dispersions, reclaim was practically the only source of polymer used until recent years. It still enjoys the major share of the business. Here again, cost has been an advantage as well as ease of processing. Water dispersions made from reclaim also show improved aging characteristics at elevated temperatures.

Q. Is there any one specific advantage for the use of reclaim?

A. Huddleston. Among the many advantages in using reclaim, the greatest single one is lowered cost. In most cases there is a saving in the volume cost of the compound when reclaim is used, but even when the reduction in compound cost is negligible or non-existent, the saving in processing cost makes the use of reclaim very profitable.

Q. With whole-tire reclaim at 10½¢ and oil-extended SBR (37½ parts oil) at less than 19¢, how is it economical to use whole-tire reclaim since the oil-extended SBR is normally used as 100% hydrocarbon?

A. Busenberg. These two types of rubber are quite dissimilar in most properties, but are in competition with one another in approximately the same price range on a rubber value basis. For some end-product uses one or the other is favored because of specific properties for that use. Some end-products can be developed around either or a combination.

One hundred parts of material can be purchased for $19.00 to $19.50 in the case of this oil-extended SBR.

Two hundred parts of material can be purchased for $21.00 in the case cited for reclaimed rubber. This consists of 100 parts rubber hydrocarbon, 35 to 40 parts of carbon black, approximately 30 to 40 parts plasticizer, 20 to 30 parts mineral fillers including zinc oxide. The value of the 100 parts of well-dispersed conventional loading cannot be overlooked. In highly loaded and extended one-step batches the use of whole-tire reclaim with predispersed materials gives almost double bulk of starting batch matrix for mixing in Banbury or on a mill.

Costs for mixing and accelerator costs are in favor of the whole-tire reclaim. Processing properties and tack properties favor the reclaim for many uses.

The question asked was specifically in regard to whole-tire reclaim. It is my opinion that oil-extended SBR has been much more serious competition in non-black goods *vs.* light-colored reclaims. Owing to scarcity of suitable scraps and consequent price, high-quality light-colored reclaims are in the 15 and 21¢ price range.

Q. Can a proportion of reclaim be used at cost advantage and still maintain properties?

A. Boyd. Yes, as there are many compounds whose physical properties requirements can be adequately met by formulae utilizing reclaim.

When one has compounds of medium physical properties, reclaim can be used in substantial amounts, reducing the volume cost of such compounds without lowering their physical properties.

Q. Have you anything to add to what Mr. Boyd has just told us about the use of reclaim in such formulations without loss of quality?

A. Huddleston. One of the puzzling things to the reclaimer is that some compounders use reclaim in all specifications compounds and praise the advantages; while others claim they cannot. Almost any reasonable specification can use reclaim in good percentages.

Citing only two examples, a factory-approved ASTM D735, R-620-AB compound uses 27.25% of the RHC as whole-tire reclaim, and a factory-approved R-420-AB compound uses 33.6% of the RHC as whole-tire reclaim.

Q. Are accelerator revisions necessary or desirable to compensate for present ratios of natural and synthetic in whole-tire reclaims?

A. Busenberg. Only minor variations of accelerator content are required, if any. I would like to point out that reclaimed rubber and compounds utilizing it can be cured with a wide variety of sulfur and accelerator ratios. Reclaimed rubber in commercial formulations is not very sensitive to minor accelerator adjustments.

The technical committee of the Rubber Reclaimers Association is now studying variations of the Standard Reclaimers Test recipe for test curing straight reclaim to see if accelerator variations from the recipe which has been used for a number of years might better reflect true physical properties of present reclaims.

Q. Although it is said that reclaim, as delivered, contains a moderate amount of zinc oxide, a reclaim-bearing stock sometimes suffers owing to insufficient zinc oxide to activate the cure properly. Does added zinc oxide beneficiate physical properties before and after aging?

A. Glenn. There is often enough zinc oxide in reclaim to give an adequate cure. Recently, however, and probably owing to the growing tendency to hold zinc oxide to a minimum in the original compounds, there is evidence of zinc oxide deficiency in some reclaims. This situation can be remedied by the addition of 0.5- to 1.0 part of zinc oxide on the reclaim rubber hydrocarbon. In addition, of course, normal amounts of zinc oxide should be added to activate the cure of new polymer in the compound.

Q. What accelerator and sulfur adjustments are necessary to cure reclaim as compared to raw polymer, i.e., SBR reclaim *vs.* SBR polymer—natural rubber reclaim *vs.* natural rubber?

A. Busenberg. In general, mixed elastomer reclaims or combinations of these reclaims and SBR cure faster than SBR alone; therefore a reduction in accelerator is possible. All reclaims are much faster curing than SBR alone.

In regard to natural rubber reclaims *vs.* natural rubber, some natural rubber reclaims are very fast in rate of cure. Neutral-process reclaims are slightly slower than natural rubber alone.

On the average, slightly higher sulfur ratios can be used with sizable increments of reclaimed rubber, without bloom.

Reclaims, although fast in rate of cure, are free from scorching problems and, in general, safe processing.

Q. What are present uses of reclaimed rubber in the flat sponge field?

A. Traflet-Hoover. Reclaimed rubber is currently being used in sponge backing for rugs as well as extruded channel rubber, kneeling pads, etc. Satisfactory automotive sponge to ASTM R11 and R12 specifications have been produced with certain percentages of reclaimed rubber. Reclaim again reduces mixing cycles and contributes to a smoother calendered sheet and extruded preparatory material. The inclusion of reclaim tends to iron out variations in blowing that might otherwise be present. Twenty to 25% of the rubber hydrocarbon of the formula may be replaced with an equivalent amount of reclaim hydrocarbon. Flat milling, well plasticized reclaims are prerequisites for these applications.

Q. Does reclaim affect adhesion to steel or brass for better or for worse?

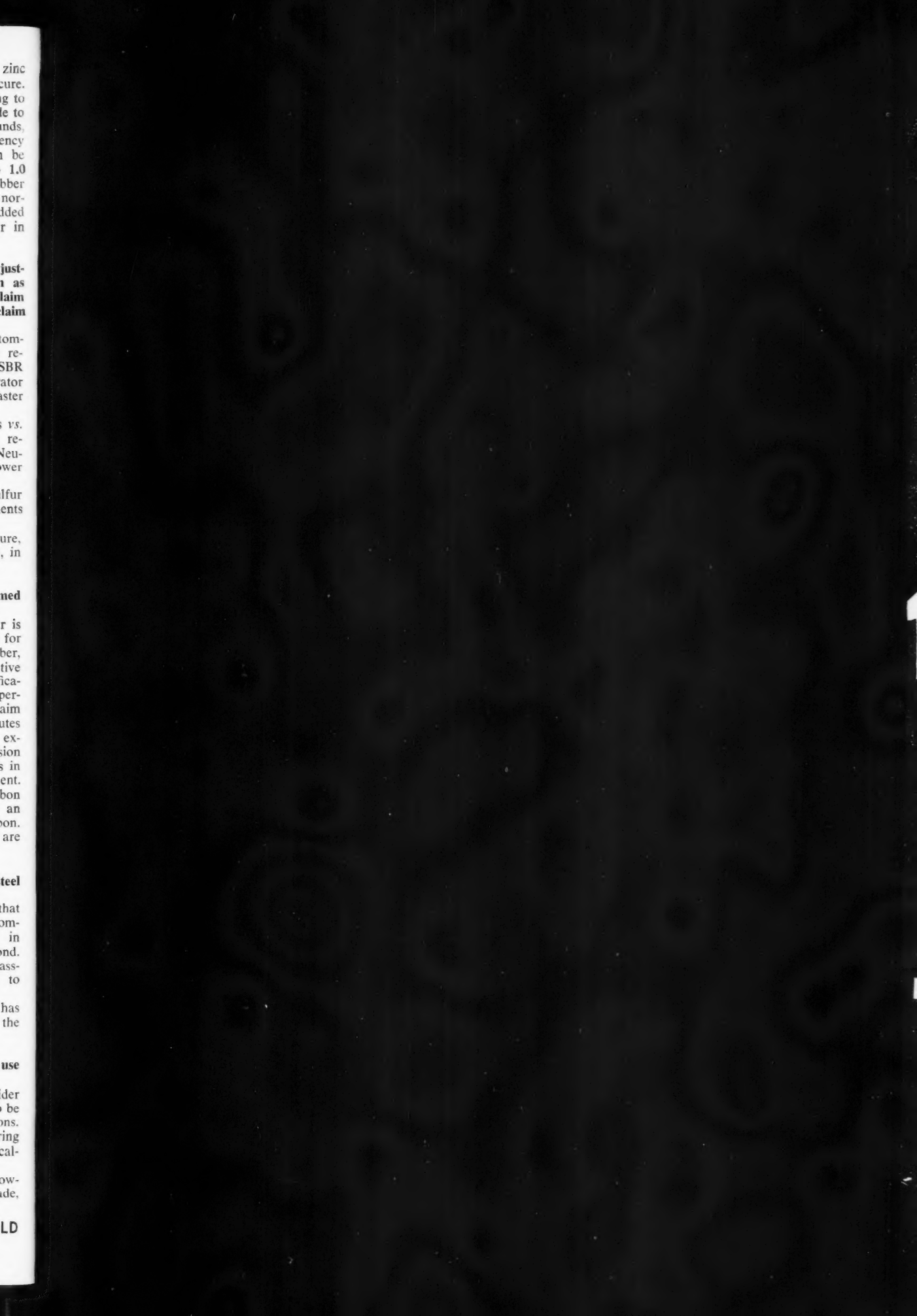
A. Boyd. It has been our experience that the use of reclaim in an adhesion compound has no deleterious effect and in many cases improves the adhesive bond. This general statement applies to brass-plated steel, chemical adhesive bond to steel or adhesion to solid brass.

In using reclaim in such stock, one has to consider other properties than just the adhesive qualities.

Q. How could reclaim be adapted to use in thin-wall wire insulations?

A. Traflet-Hoover. We do not consider reclaim, under present circumstances, to be adaptable to thin-wall wire insulations. Extrusion speeds, processing and curing costs, plus electrical requirements practically preclude its use.

Substantial quantities of reclaim, however, are still being used in code grade,



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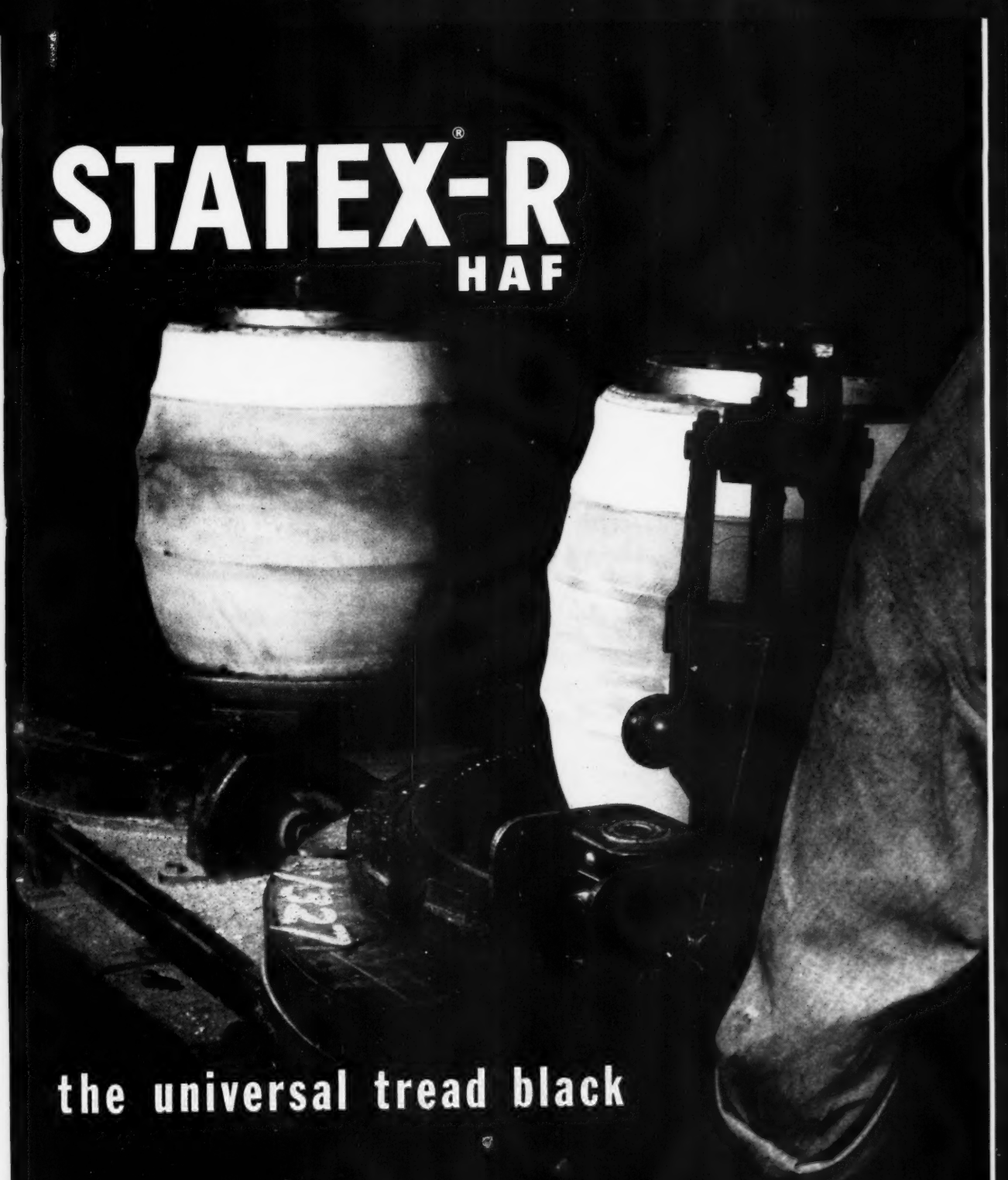

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tinsel wire, and automotive wire as well as heater cord. In the latter case the rubber insulation is frequently not vulcanized.

Q. What is the availability of neoprene reclaims and the outlook for their volume production in the future?

A. Boyd. All reclaims are dependent on the availability of satisfactory scrap. At present this is a problem with neoprene reclaims, and it does not appear likely that one can expect light-colored neoprene reclaims to be available in large quantities in the near future.

As to dark-colored neoprene reclaims scrap that is available, neoprene reclaims made from it can be used for some applications. However, if one confines his remarks to the wire and cable industry, then such a reclaim is limited to jacket covering rather than insulation. In this latter application the scrap needed is pure gum neoprene type, and such a scrap is not available in large quantities.

Q. What types of reclaim dispersions are available, and how are they used?

A. Ball. There are two main types of reclaim dispersions, designated in terms of the degree of stability desired in use. A *stable* dispersion maintains the rubber-in-water structure for the maximum length of time and is known as a "medium break" type. An *unstable* dispersion in use undergoes inversion of phase quickly and is known as a "quick break" type. The "break" or change of phase is caused by pressure, evaporation, or absorption.

An alkali digester-process natural-rubber reclaim is preferred, made from whole tire, carcass, or inner tube scrap. Contamination by synthetic rubber scrap is undesirable, as it results in the formation of tailings. The concentration of most dispersions is 50-60% solids by weight, and the method of application when used, is by roll coat, brush, spray, or trowel.

Reclaim dispersions are used as adhesives, coatings, or binders in various industries such as automotive, rug, furniture, paper, and curled hair.

Reclaimed rubber is readily dispersed, and its dispersions deposit films which have good aging properties at elevated temperatures.

Q. Is reclaim ever used in conjunction with nitrile rubber in compounding?

A. Traflet-Hoover. The author of this question does not state whether he refers to an oil-resistant or a non-oil-resistant reclaim. Reclaims are currently being prepared from oil-resistant elastomers and have found application in extruded and molded items. Processing and economical advantages are contributed by this type reclaim. Unfortunately the supply of suitable basic scrap is not too plentiful, and, as a consequence, use is somewhat limited.

Whole-tire reclaim is compatible with the oil-resistant polymers and is being used as a processing aid, and for cost reductions. The amount used is, of course, dependent upon ultimate requirements for oil and solvent resistance.

Q. Are there any limits to the amount of metal present in whole-tire reclaims and mechanical reclaims?

A. Huddleston. Improved methods of removing metal, such as mechanical separation and permanent magnetic pick-ups, produce a whole-tire reclaim essentially metal-free. Any traces of residual metal are usually non-magnetic and soft.

Mechanical reclaims present less of a problem, because their scraps do not contain as much metal.

Q. What is the market importance of reclaimed rubber in asphalt products?

A. Busenberg. The number of inquiries on this subject indicates tremendous interest at present. There are no trade statistics on tonnage of reclaim in this use.

Use of reclaimed rubber or ground scrap rubber as an additive to asphalt along with resins and other compounding ingredients is a sizable market. Some work has been done with ground scrap and powdered reclaim in experimental road and playground surfaces. Joint sealing compounds, roofing and caulking compounds, interface adhesives for bonding new concrete repair patches or resurfacing to old concrete, sound deadening compounds, protective coatings, are typical uses.

Methods of manufacture of the asphalt-reclaim products, depending on smoothness and other properties desired, vary widely, from stirring together hot to complete dispersion in heavy-duty dough mixers. Reclaim dispersions or solvent adhesives can be worked into hot asphalt, asphalt emulsions, or asphalt solvent cut backs.

Types of reclaim vary from ground scrap rubber, powdered or pelletized reclaim to reclaim in conventional slab form.

Q. Compare physical characteristics of butyl reclaim with those of reclaims from other elastomers.

A. Ball. The most important grade of butyl reclaim has a specific gravity of 1.15-1.16, which is lower than that of other important grades of reclaim. The tensile strength and ultimate elongation of about 1300 psi. and more than 500%, respectively, are higher than for most other important grades. Furthermore this high tensile strength represents a much higher proportion of the tensile of the original compound than is the case with any other reclaim; the proportion of tensile retained is at least two-thirds of that of the original compound.

The cured hardness is low, in the 40's. The air retention properties are about the same as those of new butyl rubber.

Butyl reclaim is compatible with new rubber, and the combination will cure satisfactorily. In this respect butyl reclaim has an advantage over butyl rubber. Good sunlight resistance is frequently possessed by such combinations; whereas with ordinary reclaims only one type of new rubber, viz., neoprene, is especially suitable for admixture where sunlight resistance is required. Butyl reclaim is the only reclaim which can be used with new butyl rubber.

In some processing properties butyl reclaim is better than new butyl rubber. Mixing time is usually less, and the uncured stock is less tender, which is an advantage in certain articles like inner tubes. This reclaim is like butyl rubber in its capacity for high loadings of filler; therefore smoothness of extrusion may be obtained by proper compounding.

Q. In the manufacture of reclaim, what would be the result of butyl rubber being mixed in small quantities with natural rubber scrap? Also, in the manufacture of butyl reclaim, what would happen if some natural or SBR were mixed in?

A. Huddleston. Small quantities of butyl scrap, mixed with natural rubber scrap, would not be detectable in the resulting reclaim. The butyl would act as a plasticizer, and the effect would be almost negligible in both the uncured and the cured state.

The presence of moderate amounts of natural rubber or SBR scrap mixed with butyl scrap would not greatly affect the properties of the uncured butyl reclaim, but the curing characteristics of the finished reclaim would be greatly affected, making the vulcanization progressively more difficult as the percentage of natural or SBR scrap increased.

Q. What tests do reclaimers use to insure the purity of butyl rubber scrap, and what percentage of other polymers is ordinarily present in the butyl reclaim as sold commercially?

A. Boyd. All reclaimers use every precautionary measure known to try to be certain there is not other polymer present in butyl reclaim, including:

(1) Tubes are inspected for blue lines; (2) valves and valve patches are removed from tubes; (3) cutting tests as well as burning tests are made; and (4) dead-weight tests are used.

Physical property tests are made; any other polymer contamination is readily shown by loss in physical properties. If contamination is excessive, spongy and blistered test slabs will result.

Q. What reclaims are made odor-free?

A. Glenn. There are, to my knowledge, no reclaims that are completely odor-free. Where the end-use required, however, it is possible to get special reclaims in which the odor is minimized. A good example of this was the red-tube reclaim which for years was used in considerable volume in the manufacture of jar rings.

Q. Comment on the value of compounded reclaims as compared with customer compounding of regular material.

A. Traflet-Hoover. We assume that compounded reclaims, as mentioned in this request, refer to those with specific gravities greater than 1.25. Higher gravity reclaims have been extensively used to shorten factory mixing cycles, improve dispersion, and increase tensile properties.

Dispersion of ingredients in the finished reclaim is far superior when the ingredients are included prior to the final processing as a reclaim rather than by conventional mixing. The improvement in dispersion is the result of a semi-dry mixture of reclaim intermediates or crumb with the various additives, being subjected to a mill or Banbury mixing, followed by straining and finally refining. Refiners are operated at settings to produce sheets 3 to 10 mils in thickness with resulting sheets wrapped on a drum.

Frequently this compounded reclaim is used with only curatives added on the customer's mill or in an internal-type mixer such as a Banbury. Reclaims of this nature

are produced in volume quantities only and are used in highly competitive mechanical items. Volume costs of this material run somewhat higher than a corresponding straight mix; however, the savings in reduced mixing cycles, better processing and higher physicals, more than justify the additional expense.

Q. Is there available a truly non-staining reclaim, and, if so, what is its nature?

A. Ball. There is no such thing as a completely non-staining reclaim, at least at present. Indeed, I believe it may truthfully be said there is no such thing as a completely non-staining rubber of any kind.

There is in use, however, a large tonnage of commercially satisfactory non-staining reclaim, selling at a moderate premium. The manufacture of this type depends upon the use of selected scrap, the use of non-staining reclaiming agents, and also upon the use of active carbons for absorbing any inherently objectionable ingredient. Such a product tends to be drier in processing, somewhat lower in tensile properties, and somewhat higher in cured hardness than conventional whole-tire reclaims.

Q. How effective is activated carbon in reducing staining from reclaim?

A. Huddleston. When reclaims are made from specially selected scrap, activated carbon is effective in absorbing traces of staining materials, but with ordinary scrap it is effective only to the same degree as with the selected scrap and, therefore, is not sufficient to absorb the greater amount of staining material from the ordinary scrap. Since activated carbon is a surface active agent, good dispersion, such as can be attained by incorporation during reclaiming, enhances its effect.

In general, the addition of activated carbon renders non-staining reclaims good enough to pass the staining standards of the tire and mechanical goods industries.

Q. What effect have activated carbons in reducing staining from reclaim in other than tire application, such as black matting with an inlay of white rubber?

A. Glenn. The use of non-staining reclaim is the most effective method for preventing stain from reclaim in an application such as black matting with an inlay of white rubber. Activated carbons are effective in absorbing certain staining ingredients, but will not take care of cases of severe staining. The use of activated carbon through compounding in the conventional manner to reduce staining has the further limitation of adversely affecting physical properties. As a direct result, very limited quantities of activated carbons are directly compounded in stocks of this type.

Q. What does the future hold for reclaimed rubber? What effect will the expansion of SBR production, the increasing use of tubeless tires, the possibility of tires with butyl treads, etc., have on the production and cost of reclaim and the demand for it?

A. Ball. In my opinion the future for reclaimed rubber is good.

The expansion of production of SBR types is caused partly by increased demand for rubber of all kinds, including reclaimed rubber. It is also caused partly by cost considerations in a high-price market for crude natural rubber. But truck tires are the biggest consumers of natural rubber, and there, reclaim is not so important a factor in the overall picture. In passenger tires, which use the most reclaim, the sidewall and undertread may actually permit a higher proportion of reclaim with SBR than with natural rubber. In the carcass the reverse is true in some cases, but, on the other hand, many tire companies keep the proportion of reclaim constant in the carcass, varying only the SBR and natural rubber according to relative costs.

So far as whitewall tires are concerned, the non-staining reclaim now being used is completely satisfactory at a moderate premium in price.

With regard to the forthcoming 14-inch rim tire, this represents another step toward a larger cross-section which in the past has always meant more rubber per tire. It is not yet completely clear whether or not the new 14-inch rim tire will actually use more rubber per tire; however, it does seem possible that the rubber per tire will be approximately the same. Therefore assuming a constant ratio of reclaim, this would result in approximately the same amount of reclaim per tire as with the present 15-inch rim.

Tubeless tires may contain an inner liner for improvement in air retention in addition to that offered by the carcass. The inner liner may contain reclaim, either butyl or whole tire, which therefore represents a slight gain per tire for reclaim.

If butyl tires are made, they will presumably contain butyl reclaim and therefore should not upset the total tire demand for reclaim.

On balance, therefore, we see nothing in the tire picture at this time which will greatly change the reclaim situation in the near future. For the long term the use of reclaim will share in the increased demand for rubber of all kinds because of the population growth and the increase in the number of super highways.

The most important objective for the reclaimers, in my opinion, is lower manufacturing costs to offset constantly increasing labor and freight costs. The permanent competitor of reclaim is synthetic rubber, where the proportion of labor cost is much less than for reclaim. Finally, the reclaimer must continually develop new products to meet real demands.

D-24 Carbon Black Committee Holds First Meeting; Doner Elected Chairman; Subcommittees Formed

The first meeting of the new technical Committee D-24 on Carbon Black of the American Society for Testing Materials was held June 22, in Atlantic City, N. J.[1] R. C. Alden, Phillips Petroleum Co., chairman of the steering committee in charge of the organization of the new committee, presided at the beginning of the meeting and called first for a report of the nominating committee headed by A. E. Juve, The B. F. Goodrich Co.

The nominating committee proposed S. R. Doner, Manhattan Rubber Division, Raybestos-Manhattan, Inc., for chairman; C. A. Carlton, J. M. Huber Corp., for vice chairman; and A. G. Cobbe, Godfrey L. Cabot, Inc., for secretary. There were no further nominations from the floor, and the above slate of officers was elected unanimously by voice vote. The meeting was then turned over to the new chairman.

[1] RUBBER WORLD, Apr., 1956, p. 84.

S. R. Doner, D-24 chairman

The committee on by-laws reported that the proposed by-laws had been distributed to the members. Revisions in these by-laws suggested by the ASTM staff will be incorporated, and the revised by-laws will be submitted to letter-ballot in the committee.

Frank Speight, of the ASTM staff, reported that the 13 methods of testing carbon black, as developed by the Carbon Black Industry Analytical Committee, would be published for information and comments in the July issue of the *ASTM Bulletin*.

Advisory and Subcommittees

The advisory committee will be appointed by the officers of D-24 with first consideration for membership on the advisory committee given to officers of the subcommittees.

The following members were appointed by the chairman to head the following subcommittees: physical tests, J. F. Svetlik, Phillips Chemical Co.; chemical tests, L. G. Mason, Goodrich; optical tests, J. F. Ambrose, Bell Telephone Laboratories; nomenclature, J. Tallant, Phillips Chemical; sampling, R. O. Treat, Continental Carbon Co.; and coordination, B. S. Garvey, Sharples Chemicals Division, Pennsylvania Salt Mfg. Co.

Editing of procedures developed by the subcommittees will be the responsibility for the present of the secretary of D-24.

No action was taken on the establishment of subcommittees to deal with weights and measures and reference materials.

(Continued on page 741)

NEWS of the MONTH

Washington Report and National News Summary

. . . Sale of the Government Akron Synthetic Rubber Laboratories was approved by the 84th Congress, provided no government agency wanted them, and the price obtained was high enough to pay for new facilities desired by the Department of Agriculture.

. . . The National Science Foundation's program of basic research on polymers will cost $687,000 for the current fiscal year and includes 17 research grants to various universities and industrial laboratories.

. . . The Rubber Manufacturers Association protested the Customs Simplification Bill, with special reference to footwear, and a price discrimination bill about which the tire and tube industry also was deeply concerned.

. . . The pattern for wage increases in the rubber industry for 1956 has been set by agreements between the Big Four rubber companies and the United Rubber Workers of America, AFL-CIO, calling for a 6.2¢-an-hour wage increase and an unemployment benefit plan estimated to cost an additional 3¢ an hour.

. . . The latest new rubber production and consumption estimates of the International Rubber Study Group for 1956 give production at 3,085,000 long tons and consumption at 2,975,000 long tons, with a deficit of 10,000 tons of natural, against 120,000 synthetic excess.

Washington Report

Legislation for Sale of Akron Labs Passed; Government 1956 Rubber Research Plans Given

One of the final acts of the 84th Congress was its approval of a bill to sell the government-owned synthetic rubber research laboratories at Akron, O. Congress's nod of approval on a proposed sale by the General Services Administration was conditioned, however, on a check with other government agencies to guarantee (1) that the facilities were not required by them, and (2) that the sale price to private industry was high enough to pay for new facilities that a federal agency, principally Agriculture might wish to build.

Conditions of Sale

The Senate Banking & Currency Committee, which took the lead in proposing disposal legislation, following a request by the National Science Foundation, emphasized that its recommendation to sell the Akron laboratories "is not intended, and should not be taken, as any indication of lack of support for a program of research.

"On the contrary, the committee's recommendation is based on the advice of the responsible agencies that the Akron laboratories are not needed for the basic research programs of the National Science Foundation or the Bureau of Standards or the special military research programs of the Department of Defense."

Thus the Committee cautiously gathered extensive advice from NSF and the Departments of Defense, Commerce, and Agriculture to satisfy itself that Uncle Sam could safely sell the facilities without damage to the federal research so "essential to our national security and to our industrial progress."

With this clearance from the executive branch of the government, the Committee authorized GSA to offer the facilities for sale to the public or, in default of such a sale, transfer them to any interested federal agency. GSA must canvass interested federal agencies "to ascertain the value" of the Akron laboratories to them and then attempt a private sale "at no less than this value." The Department of Agriculture could use the facilities, but suggested trying to market them instead for a price sufficient to build new laboratories for its farm research.

The Akron laboratories were constructed by the government during 1943 as part of the wartime synthetic rubber program, at a cost of $2 million plus. Although the present book value is about $545,000, the Banking Committee said it had an "informal" estimate that it would cost $3,750,000 to replace the facilities now. This estimate covers the office and laboratory building, the pilot production plant, and the related service buildings.

From 1944 until June 30 of this year the laboratories were operated by the University of Akron under a contract providing for payment of costs and an annual management fee of $50,000 by the government. With the yearly operating costs of close to $1 million in mind, the University recently rejected a government offer to rent the facilities under a free, one-year lease, without government subsidy. The laboratories were turned back to the government July 1 and have been in a standby, non-operating status since.

Government Department Comments

The Senate Banking unit, headed by shrewd Sen. J. Wm. Fulbright, (D., Ark.), asked the interested executive department offices two basic questions before agreeing to a sale: (1) Is government ownership of the laboratories necessary for an adequate research program in the fields of synthetic rubber and polymerization, and (2) would it be more advantageous to transfer the laboratories to a Government agency?

The replies to these questions included these comments:

Sinclair Weeks, Secretary of Commerce: "It is the view of the Department, now that the government has either sold or placed in a standby condition its rubber producing facilities, that there appears to

be little need of continued government operation of this laboratory, which has been engaged primarily in developing production characteristics and feasibility of new synthetic rubber rather than in basic research in the field of synthetic rubber. It would appear appropriate that research of the type carried on at the laboratory be undertaken by private industry while the government confines itself to the basic areas.

"Your letter referred to a statement from the National Bureau of Standards that was included in the report of the Special Commission for Rubber Research of the National Science Foundation[1] . . . that the Bureau would be able to make effective use of the laboratories in its program of research, testing, and standardization. The statement, however, was predicated on the assumption that the Federal Government would continue to sponsor an extensive program of synthetic rubber research. Since the Special Commission . . . has recommended discontinuance of the present program of government-sponsored rubber research projects and this recommendation has been accepted by the Administration, the assumptions on which the comments of NBS were made no longer apply."

William M. Brucker, Secretary of the Army: "The Department of Defense does not believe that the Akron facilities can be used to advantage, commensurate with cost of operation, in the overall synthetic rubber program or specifically for furthering the development and application of synthetic natural rubber. Utilization by the military and their contractors of the Akron laboratories has been principally in the area of polymerization of diene monomers. It is in this particular field that the Akron laboratories possess the capabilities and facilities which have been of most value to the Department of Defense rubber program. . . . Major military emphasis in synthetic elastomer development is now concentrated in other areas of rubber chemistry for which the Akron laboratories and the scientific skills of their personnel are not well suited.

"With respect to utilization of the Akron facilities in connection with the new synthetic natural rubber, *cis* polyisoprene, it is to be noted that development work has reached the point where the principal technical problems are ones of compounding, evaluation, and the development of fabrication techniques. Adequate facilities and skills for the successful accomplishment of this phase are available within the Department of Defense and the rubber industry."

True D. Morse, Acting Secretary of Agriculture: "For the fiscal year ending June 30, 1957, the Congress has provided an expansion of research in the field of finding and developing new industrial uses for agricultural products. While it would be possible to conduct our research program within our presently existing utilization laboratories, it is evident at this time that more effective utilization research could be carried out if additional laboratory space were immediately available. . . .

"The Akron laboratory is equipped for the conduct of research on the production of industrial raw materials, plastics and rubber-like materials from agricultural surpluses. . . . We are prepared to start alterations immediately within existing authority, should the facility become available to this Department, and complete the alterations when additional authority is obtained. It would be possible to accomplish the transfer of this facility to the Department of Agriculture without legislation."

[1] RUBBER WORLD, Feb., 1956, p. 684.

Further Highlights

Highlights of the Fulbright committee's pre-approval investigation of the proposed sale were (1) fairly complete reports of present and planned research activities in the polymer field, and (2) disclosure that the government is trying to get Goodrich-Gulf Chemicals, Inc., to make public its technique for pilot-plant production of synthetic natural rubber.

Alan T. Waterman, director of the National Science Foundation, told the committee that both Goodrich-Gulf Chemicals, Inc., and Firestone Tire & Rubber Co. have developed different processes for producing pilot-plant quantities of this material. He also reported that Goodyear Tire & Rubber Co. and Phillips Petroleum Co. have made substantial progress in this field.

"Inasmuch as none of these processes is in full-scale production," Dr. Waterman observed, "there is obviously the need of further applied research to perfect the processes for production. However, there is no apparent need of further fundamental research in this field to the extent that there was before these processes were announced. The possibility of commercial production in the immediate future appears to be slight because of the rather high cost of these processes and the decreasing price of natural rubber over recent months.

"In view of this price situation and the increased butadiene-styrene synthetic rubber capacity scheduled for the near future, it is believed that the companies will proceed in a methodical, rather than hasty, manner to develop these processes toward commercial-scale operation, since a plentiful supply of butadiene-styrene synthetic will tend to hold down the price of natural rubber. We anticipate that some commercial plants may be operating by 1960. . . .

"For a number of years the government supported synthetic rubber research by various companies concerned with the production of synthetic rubber. . . . These [research] contracts contained a defined scope within which the research was conducted, and required that the firms make available to the government all information within the scope of the contracts. Information coming within the scope of the contracts could be utilized freely by the government and its nominees.

"Of the companies which have made discoveries of a synthetic duplicate of natural rubber, only Firestone has fully revealed publicly the nature of its processes. Goodrich-Gulf, in response to requests from the Federal Facilities Corp., has refused to divulge the nature of its discovery, which had been announced before the termination of their research agreement with the government, on the ground that its discovery is not covered by the research contract.

"The rights of the government in connection with these new processes are now under consideration by FFC and NSF, with a view to making certain that the government's rights in this area are fully protected."

NSF's 1956 Research

With respect to NSF's program of research in the general area of molecular structure and the arrangement, composition, and properties of high polymers and their methods of preparation, Dr. Waterman said the Foundation would spend $687,000 during the current fiscal year to support 17 research grants in the field of high polymers. Of this total, $537,000 will go to schools already active in the program; the rest to institutions not previously associated with this program, but which requested support for research on high polymers.

The problems to be investigated and the institutions involved are: (1) mechanism of the heterogeneous addition polymerization, University of Akron; (2) rheology of suspensions of spherical particles and of polymer solutions, Case Institute of Technology; (3) chemistry of polymerization and the chemical properties of polymers, University of Chicago; (4) polymers in strong electrical fields and porous media flows, and (5) properties of polymers and their solutions, Cornell University; (6) synthesis and relation between structure of high polymers, and (7) mechanics of coiling-type polymer molecules, University of Illinois; (8) polymerization and polymers produced by organoalkali metal reagents, Massachusetts Institute of Technology; (9) physical properties and molecular parameters of polymers, Mellon Institute; (10) kinetics and mechanism of emulsion polymerization, University of Minnesota; (11) rheology and thermodynamics of polymers, NBS; (12) synthesis and characterization of inorganic polymers, Cornell; (13) phosphorus-nitrogen compounds and their derivatives, Illinois; (14) chemistry of the condensed phosphates, Johns Hopkins University; (15) stereoisomerism of vinyl polymers, and (16) polymerizations initiated by electron-transfer to monomer, New York University; and (17) mechanical properties and polymer structure, University of Wisconsin.

The total number of professional personnel working under this 17-grant program of NSF was estimated by Dr. Waterman at 32 full-time and 30 half-time workers. Six months ago, he noted, there were 49 full-time and 41 half-time personnel employed under government-sponsored synthetic rubber contracts.

NBS Research

Meanwhile, in another area of government research, A. V. Astin, of NBS, reported to Congress that the Bureau will undertake at least four projects this year on molecular structure and polymers, including natural and synthetic rubber. These include stability of polymers, properties of polymers, polymer standards, and analysis and identification of plastics. Ultimate aim of NBS research work is a rubber having properties superior to those of both natural rubber and the synthetic rubbers currently available.

Defense Department Research

The military's research efforts, on the other hand, are devoted to two principal areas: (1) development of new elastomers or elastomeric materials to meet specific military needs where industry has no competitive or commercial incentive; and (2) application of newly developed elastomers and available commercial rubbers to end-item requirements. The Pentagon has dropped its work on synthetic natural rubber, except for laboratory evaluation of samples furnished by industry. Also, Defense has ordered heavy-duty truck tires for road-wear tests and some experimental aircraft tires for delivery this fall.

Army Chief William Brucker lumps the military's rubber problems into these six categories: (1) chemical and fuel-resistant elastomers serviceable at temperatures as low as –65° F.; (2) elastomers for use at temperatures as high as 400° F., with an ultimate goal of 700-1000° F.; (3) synthetic rubber suitable for aircraft and heavy-duty truck tires; (4) fire-retardant rubbers for use in clothing; (5) radiation-resistant rubbers for use in nuclear power systems; and (6) prevention of rubber deterioration in outdoor weathering and storage.

"The Department of Defense research effort in the development of new elastomers," according to Brucker, "is concentrated in the fields of fluorocarbons, modified silicones, polysulfide-silicones, organo-metallic compounds, and inorganic polymers. Work in these particular fields has been the most fruitful to the military, especially with respect to acid- and fuel-resistant rubbers for use under extreme temperature conditions.

"These areas of investigation hold the most promise at this time of solving the major elastomer problems for the Department of Defense. In this connection, two acid- and fuel-resistant rubbers serviceable at –15° F. and thermally stable at 400° F. have been developed under government contract. These materials are currently in pilot-plant production."

Federal Highway Bill Passed; Tires, Tread Rubber Tax Up

One of the most outstanding achievements of the 84th Congress was passage of the Federal Aid Highway and Highway Revenue Acts of 1956, a combined 13-year program to expand and modernize the interstate highway system and a three-year program of regular federal-aid-to-highways funding. The rubber industry stands high among those industries likely to gain the most from this new aid to more satisfactory automobile and truck transportation. Between now and 1959 the Federal Government will spend more than $33 billion on the nation's roads, $25 billion for the interstate system; $2.55 billion to improve existing systems; $289 million for public domain roads; and $5.3 billion in matching state funds for interstate and existing systems.

The $25 billion authorized for the 41,000-mile interstate system will be made available to the states on the basis of a 10/90 ratio, state and federal contributions, with individual states getting their amounts according to population, area, and rural road mileages during the first three years of the program. During this three-year period the formula will be on a trial basis, subject to change from 1960.

To raise the staggering amounts necessary to fund the program, Congress agreed to increase certain tax rates and impose new taxes on gasoline, diesel fuel, tires, tread rubber, and trucks. Estimated return from the new taxes, which became effective July 1 and run through June 30, 1972, is $14.8 billion; the existing tax structure in these categories will swell the fund, during the same period, by $23.7 billion, for a total of $38.5 billion.

The tax on tires was increased from 5¢ to 8¢ a pound, and a tax of 3¢ a pound has been imposed on tread rubber where no such tax existed previously. The tax increases were applied to floor stocks on trucks, buses, and truck trailers, tires, tread rubber, and gasoline held by a dealer on July 1, but payment will not be required until after September 30. When the excise increase expires in 1972, the government will refund on all floor stocks on hand July 1, 1972.

RMA Protests Customs Price Discrimination Bills

Rubber industry spokesmen made two major appearances on Capitol Hill before the 84th Congress went into the history books. John G. Lerch, a New York attorney, made an unsuccessful plea on behalf of the Rubber Footwear Division, The Rubber Manufacturers Association, Inc., against adoption of the Customs Simplification bill—a bi-partisan approach to the very complex problem of evaluating imports and applying a tariff. Lerch appeared before the Senate Finance Committee, which subsequently approved the bill and started it on its way to the White House, where President Eisenhower signed it last month.

Eugene Z. DuBose, an attorney with the RMA, followed Mr. Lerch to the Hill to protest adoption of the so-called "good faith" bill—a measure designed to outlaw price discrimination where the seller changes his price in good faith to meet competition. DuBose testified before the Senate Anti-Trust & Monopoly Subcommittee on behalf of RMA's Tire and Tube Division. The measure was passed by the House by a margin of 300 votes, but died in the Senate when a number of spokesmen for small business—for whose benefit the bill was originally intended—complained it would do more harm than good.

Customs Bill Passed

Under the new Customs Simplification Bill, the Treasury Department will appraise imports, for tariff purposes, on the basis of export price offered to a buyer in this country. The formula will not apply, however, where it will reduce the value of a particular item more than 5%. Under the old system the Treasury determined the "offered for export" value and the price of the item's sale in the originating country—then the tariff was applied in terms of the higher of the two.

Lerch said the bill would "further reduce existing rates of duty" on imported rubber and other items by an amount discretionary with the appraising officials. He called the measure "one of the most vicious that has been yet proposed under the guise of customs simplification." Other attempts to "destroy" protection of American industry and labor, he said, "have at least been forthright in their statement of the ends to be accomplished." He accused the bill's sponsors of abandoning 100 years of customs practice and judicial precedents "in exchange for a system predicated upon discretionary powers exercised by government officials"—a system which "will not conform to an orderly administration of our customs law."

Price Bill Dies

DuBose, arguing against the "good faith" bill, warned against promoting price rigidity to the detriment of consumers, a warning repeated by other industry representatives. In effect, he was arguing for a seller's right to lower his price, for example, to one of five customers, where the reduced price was absolutely necessary to keep the customer from straying to a competitor offering a lower price. Witnesses before the subcommittee repeatedly pleaded that loss of such freedom in doing business would allow a large firm to move into any area and gobble up the market.

"We urgently request," DuBose testified, "that in the interests of the sellers, large, medium, and small, the proposed bill be rejected, or at least that further intensive, realistic consideration be given to any proposal to permit lessening of competition at the seller's level."

He declared that the bill would "clearly foster price rigidity in the tire industry" and would prevent the purchasing public, to that extent, from receiving the "full benefit of prices arrived at through effective competition among manufacturers and sellers."

NSF Report on Research by Cooperative Organizations

The National Science Foundation has published a report entitled, "Research by Cooperative Organizations," in which the amount and scope of scientific research and development by trade associations and other cooperative groups are given in some detail. The report was prepared by the Battelle Memorial Institute and is one of a series which, when completed, will provide the first overall view of scientific research and development in the United States.

In 1953, 543 cooperative groups, including trade organizations, professional and technical societies, agricultural cooperatives, and research-educational cooperatives, spent $21 million for research and development. Except for a small amount spent for social science research, practically all of it was spent for technical

research and development, divided into about 70% for applied research and 30% for basic research.

One-third of the organizations reporting expenditures for technical research and development (173), spent seven-eighths ($18 million) of the total dollar value of such research. Trade associations accounted for 60% of the expenditures, agricultural cooperatives for 15%, professional and technical societies for 10%, research-educational cooperatives for 5%, and other miscellaneous groups for 10%.

Of the industrial organizations reporting, the rubber products manufacturing industry association (presumably the RMA) spent $23,000. Sixteen organizations in the chemical and allied products field spent $972,000, and 29 cooperative organizations in petroleum and coal spent $1,274,000.

BDSA Names 83 to New National Defense Reserve

Secretary of Commerce Sinclair Weeks has designated 83 executive employes of private industry members of the recently established National Defense Executive Reserve, which will serve in the Business & Defense Services Administration of the Department of Commerce in the event of a future mobilization emergency.

Invitations to join the Reserve had been sent to 620 individuals since the recruiting program start last March. In addition to those designated for service, 223 are in the process of being certified for security classification, Secretary Weeks revealed.

In peacetime, those selected are required to maintain liaison with the government agency to which they are assigned, to attend announced training sessions and alert exercises when possible, and to participate in the study of mobilization plans and programs.

In time of emergency the reservists would become immediately available for full-time assignment in the BDSA unit of the Department of Commerce. Secretary Weeks stressed that the reservists will not become actual government employes, serving either with or without compensation unless they are put on active duty with a full-time assignment.

Among the 83 reservists selected who are familiar to the rubber industry are the following: John A. Field, Carbide & Carbon Chemicals Co.; George W. Flanagan, and George A. Fowles, B. F. Goodrich Chemical Co.; Thomas S. Mohr, Taylor Instrument Cos.; Albert H. Wechsler, Converse Rubber Corp.; Herbert W. Bertine, Allied Chemical & Dye Corp.; John H. Spraggon, Westinghouse Electric Corp.; George E. Peterson, Simplex Wire & Cable Co.; and Stuart E. Yeaton, John A. Roebling's Sons Corp.

Congress Ends All Tire Testing by U. S. Army

Some of the nation's tire-testing facilities stand to get little increased business from the U. S. Army Ordnance Corps in the wake of a blistering attack on the Corps' tire-testing program by Rep. R. Edward Hebert, (Dem., La.) and his Special Investigations Subcommittee on Armed Services.

A contract with a West Coast firm to test military tires at Camp Bullis, Tex., expires in August, and its renewal will come only over Hebert's dead body. Target of his blast in July was a $1-million expenditure by the Army over a three-year period, to learn the possibilities of higher synthetic content in Army tires under hot weather conditions, to maintain an active synthetic rubber production, and to improve on manufacturing techniques. The Corps' explanation that no suitable commercial testing was available was met by the Hebert contention that the Army put its tires to no test that is not applied by U. S. tire manufacturers for tires used by the civilian construction and trucking industries.

"Commercial facilities test tires in heat, on rough terrain, for bruising, for durability, and for all of the performance tests which are required," he chided. "The difference is that in the case of commercial facilities, the tires which are being tested are sold commercially, and in the case of the Army testing, the work is being done upon a mongrel, outmoded, outdated, non-commercial tire to be used on military vehicles" [9.00 x 20 eight-ply, as against the 9.00 x 20, 10-ply which are produced by 24 of the country's tire manufacturing companies.]

The legislator hopes he put the Army out of the tire-testing business for good when he summed up the situation this way: "All facilities used by the Army are already in existence and in use by commercial concerns . . . and these tests can be performed and are being performed with a fraction of the total personnel employed by the Army at Camp Bullis."

National News

1956 Wage-Increase Pattern Set at 6.2c an Hour Layoff Pay Plans Instituted for the First Time

Negotiations between major rubber companies and the United Rubber Workers of America, AFL-CIO, which were aimed at a wage increase for production workers and which began in late June and early July, resulted in new contracts in many instances before the end of July. Wage increases of 6.2¢ an hour were granted, and, in addition, the new agreements provided for a supplemental unemployment (SUB) plan which will provide for about 65% of a worker's straight-time pay, including state unemployment insurance benefits, in event of layoffs.

The direct hourly wage increases were effective at various times during the month of July; while details of the SUB plan were to be worked out in most cases at a later date. The new contracts required ratification by the local unions involved, but this was considered to be automatic.

The 6.2¢-an-hour wage increase is less than that obtained by the union in 1955 when an increase of 12¢ an hour and fringe benefits averaging 4¢ an hour provided for about a 16¢-an-hour increase. One company indicated that the SUB plan would cost an additional 3¢ an hour so that the 1956 gain might be considered as equal to 9.2¢ an hour.

Union gains in hourly increases for workers in 1955 were the highest since 1946, but the record production pace of last year has not been maintained this year by the rubber companies, and they were in a better position to resist demands for increases of the magnitude of those granted in 1955. A number of layoffs have been necessary in 1956.

Goodrich Contract

The new contract between The B. F. Goodrich Co. and the URWA, agreement on which was reached 45 minutes before the strike deadline of 12:01 a.m., Sunday, July 15, covered 13,500 workers in nine plants and provided for the 6.2¢-an-hour increase retroactive to July 9, and a supplemental unemployment benefit plan. The contract is subject to ratification by the local unions involved and the executive board of the international URWA union. Under the wage reopening provision, the union can cancel the contract 60 days after notifying the company that it wants to reopen the contract.

The details of the SUB plan will be worked out at a later date and will require evaluation and understanding of state and/or federal unemployment insurance benefits which will become a part of the final SUB plan.

Other Contracts

Goodyear Tire & Rubber Co. signed an agreement on July 17 for a 6.2¢-an-hour wage increase and the SUB plan similar to the Goodrich agreement. The increase was effective July 16 and covered 14,000 production workers in Akron, O., and 10,000 additional workers in nine plants in other states.

The same wage increase and commitment for about the same type of SUB plan were agreed to by United States Rubber Co. on July 20 and by Firestone Tire & Rubber Co. on July 21, in New York, and Columbus, O., respectively.

Employment by States

The May issue of the Department of Commerce's "Industry Report—Chemical and Rubber" included March, 1953, figures on employment in the rubber industry by states, as taken from the Bureau of Census publication, "County Business Patterns, Part I."

According to this source, rubber goods manufacturing is carried on in 38 states, the District of Columbia, and Hawaii. Of the 271,516 production workers employed by the industry in 1953, Ohio accounted for 29.8%, Massachusetts, 10.3%, California, 6.1%, and Indiana, New Jersey, Pennsylvania, and Connecticut, more than 5% each.

The table below gives the number of production workers and the percentage of total for this March, 1953 period.

U. S. Rubber Goods Employment by States

State	Workers	% of Total
Ohio	80,930	29.81
Mass.	27,940	10.29
Calif.	16,457	6.06
Ind.	16,219	5.97
N. J.	15,151	5.58
Penn.	14,929	5.50
Conn.	14,112	5.19
Mich.	12,956	4.77
N. Y.	9,312	3.43
Ill.	8,612	3.17
R. I.	7,638	2.81
Md.	6,882	2.54
Tenn.	5,921	2.18
Colo.	5,311	1.96
Ala.	5,181	1.91
Wis.	4,628	1.70
Iowa	4,210	1.55
Tex.	2,138	0.79
Okla.	1,362	0.50
Del.	1,176	0.43
N. C.	1,172	0.43
Neb.	1,045	0.39
Miss.	1,028	0.38
Mo.	857	0.32
N. H.	837	0.31
Va., Utah, Ga., Oreg., Me., S. C., Ky., Ariz., Ark., D. C., Minn., Vt., Wash., W. Va., Hawaii	1,548	0.57
	3,964	1.46

It was pointed out that for states such as Ohio having a large production of tires and tread rubber the rubber throughput per worker is greater than in states producing primarily footwear, mechanical goods, and drug sundries which require more labor per ton of rubber. It might be added that except for the states of Ohio, Massachusetts, California, and New Jersey, the number of employees and the number of plants, are not necessarily of the same order of magnitude. As shown elsewhere in this issue, the number of plants in New York, Illinois, and Pennsylvania is between 100 and 200, as is the case with Ohio, Massachusetts, California, and New Jersey, but the number of employes in the first case is much less.

IRSG 1956 Rubber Statistics

The management committee of the International Rubber Study Group, following a meeting in Paris, France, in mid-June released its latest estimates of new rubber production for 1956 at 3,085,000 long tons, an excess of world consumption of 110,000 long tons. These figures do not include estimates of synthetic rubber production or consumption for Eastern Europe, Russia, or China.

The American rubber industry was represented at this IRSG meeting by Ross R. Ormsby, RMA president, and Leonard Smith, U. S. Rubber.

World production of natural rubber was estimated at 1,835,000 long tons, and world production of member countries at 1,250,000 long tons. World consumption of natural rubber is expected to amount to 1,845,000 long tons and of synthetic rubber, 1,130,000 long tons.

The tables below provide detailed statistics from the IRSG concerning estimates for the current year and final figures for the previous year.

Synthetic Rubber Production

1956 Estimates, 1955 Actual
(1,000 long tons)

Territory	1955	1956
United States of America*	970	1,125
Canada*	104	113
Federal Republic of Germany	11	12
Total	1,085	1,250

* Includes oil content of oil-extended rubbers.

Natural Rubber Production

1956 Estimates, 1955 Actual
(1,000 long tons)

Territory	1955	1956
Indonesia	734	680
Malaya	639	630
Thailand	130	123
Ceylon	94	91
Viet-Nam	66	66
British Borneo	61	53
Liberia	38	38
British Africa	31	30
Cambodia	26	28
Belgian Africa	26	27
Burma	11	12
French Africa	3	4
Papua	3	3
Other countries	50	50
Total	1,912	1,835

The IRSG Committee increased its estimates of eastern Europe and Russian imports of natural rubber by 100% over 1955 and for China by 50%. Observers in some instances felt that these sharp increases in estimates were unrealistic, and should this belief prove correct, actual consumption might lead to a further increase in free stocks, it was further explained.

Consumption, Natural and Synthetic

1956 Estimates, 1955 Actual
(1,000 long tons)

	1955			1956		
Territory	Natural	Synthetic*	Total	Natural	Synthetic*	Total
U.S.A.	635	895	1,530	550	880	1,430
U.K.	246	21	267	212	45	257
Germany, West	148	†25	173	132	†36	168
France	134	20	154	130	30	160
Japan	88	4	92	92	7	99
Canada	44	40	84	41	46	87
Italy	57	13	70	57	13	70
Australia	45	1	46	36	12	48
Belgium	21	5	26	22	5	27
Netherlands	20	2	22	21	3	24
Denmark	6	0	6	7	1	8
Hungary	5	0	5	7	0	7
Other countries	419	36	455	538	52	590
Total	1,868	1,062	2,930	1,845	1,130	2,975

* Excluding synthetic rubber production in non-member countries.
† Excluding oil content of oil-extended rubbers.

D-24 Committee

(*Continued from page 736*)

CBIAC Round-Robin

Mr. Carlton reported on the results obtained in the round-robin on the carbon black tests carried out in the laboratories of the members of the CBIAC. He suggested that his recommendations regarding the adoption of the tests be deleted from the record.

The use of a 415-425 mμ filter in the benzene discoloration test and whether or not the absorption band for the blacks used was typical of all blacks were referred to the optical methods subcommittee.

Tests under consideration were allocated to the following indicated subcommittees: pellet size distribution, screen residue, attrition of pelleted black, fines, pour density, and mass strength of black, to the physical tests subcommittee; solvent extractable material, iodine number, heating loss, volatile content, pH, and ash content, to the chemical tests subcommittee; and degree of discoloration in benzene, to the optical methods subcommittee.

It was also suggested that the chemical subcommittee consider tests for nitrogen absorption, oil absorption, and sulfur content, and that future work on color of blacks and direct particle-size measurement be considered by the optical subcommittee. Tests for flow and wettability will be considered by the physical test group.

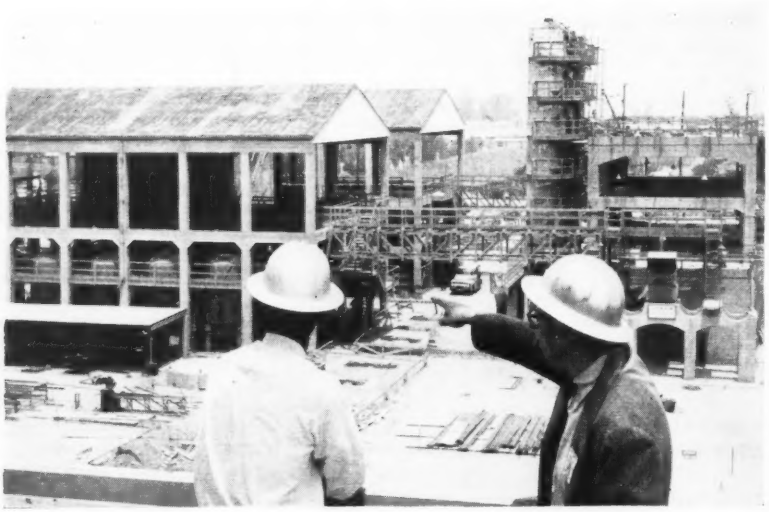
Hydraulic Hose Selector

Republic Rubber Division, Lee Rubber & Tire Corp, Youngstown, O., is making available a "Rubber Covered Hydraulic Hose Selector" to users of hydraulic control hose. The revised selector contains the latest SAE and industry specifications on hydraulic hose and aids designers and maintenance men in choosing the proper Wiretex hose from the company.

Requests for the selector should be addressed to the company's Wiretex hose department.

Other Industry News

Shell Adding SBR Latex Unit, Expanding Torrance Plant



Engineers gage progress of new construction at the copolymer unit of Shell Chemicals synthetic rubber plant at Torrance

An expansion program is under way at the Torrance, Calif., synthetic rubber plant of Shell Chemical Corp., New York, N. Y., R. C. Mc Curdy, president of the company, revealed.

Being built is a new unit for the production of cold high solids SBR latex 2105, the first time raw material of this type for the manufacture of foam rubber goods has been available west of the Rocky Mountains. The installation will be completed some time this fall.

Also expected to be completed at about the same time are extensions to the plant's butadiene facilities and modernization of the copolymer unit. A new research laboratory and pilot plant will be ready in early 1957.

Expansion of the copolymer plant will increase its annual capacity from 89,000 to 110,000 long tons, barring unforeseen shortages of raw materials.

The first stage of the modernization program began soon after the company bought the Torrance plant from the government last year, and other stages were added as the need became evident, Mr. Mc Curdy said.

NBS Plans Relocating Labs

A 550-acre tract of land near Gaithersburg, Md., has been selected for the relocation of the Washington, D. C., laboratories of the National Bureau of Standards. Funds for the acquisition of the site and preliminary planning for new facilities were recently appropriated by Congress.

According to the Bureau of Standards, the move will permit the planning of new buildings to replace present research facilities, which over the past 50 years have become inadequate for its current needs. Space for expansion is not available at the existing location. Transfer of operations is expected to be completed in five years.

The Bureau occupied its present site on Connecticut Avenue in Washington in 1903. The growth of scientific research and technology in this country since that time has increased the responsibilities of the government agency, making the projected new labs necessary.

Scotch Tape Patent Valid

A United States District Court has upheld the basic cellophane tape patent of Minnesota Mining & Mfg. Co., St. Paul, Minn. The ruling declared the company's patent to be valid and infringed by Technical Tape Corp., New York, N. Y. The 3M cellophane tape is sold under the trade name "Scotch" Brand.

The litigation began in 1951 when Technical Tape filed a declaratory judgment suit asking for a declaration that 3M's patent was invalid. Minnesota Mining then filed a counterclaim asking for an injunction to stop Technical Tape from infringing the patent and requesting an accounting of damages.

The 3M patent, originally granted to Richard G. Drew, now head of the 3M products fabrication laboratory, was upheld once before, in 1947.

The company won another patent suit on June 12 when the U. S. District Court for the middle district of North Carolina held that the 3M basic patent on vinyl plastic electrical insulating tape was valid and had been infringed by Sears Roebuck & Co., Plymouth Rubber Co., and other firms.

Rigid PVC Reagent Pump

What is called the first completely corrosion-resistant reagent pump has been placed on the market by Clarkson Co., San Francisco, Calif., according to the plastics division of The Seiberling Rubber Co., Akron, O., which manufactured the rigid unplasticized polyvinyl chloride that composes the pump's parts.

The full cover around the gear motor, the molded tank, float valve, and all other parts except the motor are made of Seiberling's PVC. The parts were fabricated by K-Plastix, a San Francisco firm.

According to Seiberling, the new feeder is capable of handling a top flow of 25 gallons of any grade of acid per hour without reaction. Maintenance costs due to corrosion are said to be eliminated for solutions of copper sulfate, ferric chloride, and caustic soda, as well as other acids. The full plastic cover also provides protection for outside use around cooling towers.

Colombia Cites Litchfield

P. W. Litchfield, chairman of the board of The Goodyear Tire & Rubber Co., Akron, O., was awarded the Order of Industrial Merit by the Republic of Colombia at the recent opening of the company's new tire plant in Yumbo, Colombia. F. T. Magennis, vice president and general manager of Goodyear Foreign Operations, witnessed the ceremonies.

The plant is now in full-scale production of tires and tubes.

BFG's Manila Plant Names

John R. Dietrich has been named factory manager of The B. F. Goodrich Co.'s new associated plant near Manila, the Philippine Islands, it has been announced by W. C. Gulick, president of International B. F. Goodrich.

Also assigned to the plant are Vincent B. Gay, as technical advisor on tire construction, and R. K. Liese, as technical advisor on tire compounding. Lewis C. Hayden, who has represented Goodrich in the Philippines since 1930, is executive vice president and general manager of the new plant.

Tire production is scheduled to begin at the plant this fall. A daily output of 500 passenger, bus, and truck tires is expected.

Blaw-Knox to Design, Build Britain's First GR-S Unit

The chemical plants division of Blaw-Knox Co., Pittsburgh, Pa., has been awarded a contract for the design and construction of Great Britain's first synthetic rubber plant to be built at Fawley, England, by International Synthetic Rubber Co. at a cost of $12,000,000.

The plant will have an annual capacity of 50,000 tons of SBR synthetic rubber and will take about two years to build. Butadiene will be supplied the plant from the adjacent petroleum refinery of Esso Standard Oil Co.

International Synthetic Rubber Co. was formed by Dunlop Rubber Co., Ltd., in association with The Goodyear Tyre & Rubber Co. (Gt. Britain) Ltd., The Firestone Tyre & Rubber Co., and Michelin Tyre Co., Ltd.

In addition to the plant, Blaw-Knox will also erect administration, laboratory, machine shop, warehousing, packaging, and shipping buildings.

During World War II, the company was selected by the Defense Plant Corp. of the United States Government to coordinate all information available from the major rubber companies and to design the prototype of the standard GR-S synthetic copolymer plant.

Tyer Marks Centennial with All-Day Festivities

Lenscraft Photos, Inc.

Shown discussing rubber footwear and other matters at the recent one hundredth anniversary celebration of Tyer Rubber Co. are, left to right, Hugh Bullock, former president of the firm; S. W. Bartlett, board chairman; W. E. Brimer, president; and James Gillespie, 50-year veteran of Tyer's sales force

Nearly 3,000 people attended an "open house" at the Andover, Mass., plant of Tyer Rubber Co. in celebration of the firm's one hundredth anniversary. The all-day festivities included a tour of the company's footwear and sports equipment, as well as its industrial rubber goods production facilities.

Wallace E. Brimer, Tyer president, welcomed the guests and thanked "the people of the Greater Lawrence Area who have contributed to the tremendous growth and success of Tyer Rubber Co. during the past one hundred years."

Goodyear Finishing Biggest Warehouse in the Industry

What is called the largest warehousing facility in the rubber industry, The Goodyear Tire & Rubber Co.'s $5-million distribution center at Brook Park, near Cleveland Airport, O., is scheduled for completion in November, with sections of the warehouse available for occupancy in September, the company has revealed.

When completed, the building will have nearly 15 acres of warehouse space under one roof. The warehouse section of the structure will be 1,440 by 440 feet, with an additional 21,786 square feet of space to be reserved for the company's central sales division and Cleveland district sales and operating personnel. The merchandising area will total 633,600 square feet.

About 150 people will be employed at the warehouse, and an additional 75 will be associated with the Goodyear sales offices. When the St. Lawrence Seaway is opened in 1959 or 1960, the warehouse will facilitate the handling of some of the company's export business through the port of Cleveland, according to Goodyear.

Being constructed of steel and masonry, the warehouse will have loading facilities for 57 trucks which will extend for more than a quarter of a mile along the west side of the building. Brook Park is located near the Ohio Turnpike.

Tracks of the New York Central Railroad will run the full length of the building's east side, with a capacity for 30 railroad cars within the building. A system of pneumatic tubes, more than 6,400 feet long, will facilitate the rapid transmission of orders to eight stations.

Rogers Acquires Cellular

Rogers Corp., Rogers, Conn., has purchased Cellular Rubber Products, Inc., Willimantic, Conn., manufacturer of cellular and mechanical rubber products for special-purpose aircraft and electronics applications.

The Rogers firm, producer of specialty materials for the electrical insulating, plastics, shoe, automotive, and other fields in its Rogers and Manchester, Conn., plants, will boost the production capacity of its new acquisition.

The entire Cellular work force of about 50 employes will be retained, increasing Rogers' personnel total to about 450, the company revealed.

Seiberling Colombian Plant

Seiberling Rubber Co.'s new affiliate tire plant in Bogota, Colombia, S. A., which began production last March, is currently operating at 60% capacity and is now the second largest American tire producer in Colombia, according to Harry P. Schrank, executive vice president of the Akron, O., firm.

Fifteen thousand square feet of manufacturing space were recently added to the Bogota plant, which will incorporate facilities from the company's industrial products division, called Almacen Villegas, located five miles outside the city.

Almacen Villegas is Colombia's largest manufacturer of rubber tile flooring and one of South America's leading manufacturers of footwear and tread rubber for recapping, Mr. Schrank said. The plant addition will begin operations in September.

Operating Pelmor Labs

Coleman P. Morgan Associates, Trenton, N. J., consultants to the rubber and plastics industries, are now operating Pelmor Laboratories, Inc., Newtown, Pa., according to Coleman P. Morgan, president of the Trenton firm and former chairman of the hard rubber subcommittee of Committee D-11 of the American Society of Testing Materials.

The new laboratory facilities are equipped to handle such services as rubber and plastics compounding and formulation, testing, processing and methods, development projects, lab planning and organization, and mold design and engineering, the company revealed.

Synthetic Patents on Film

Microfilm copies of 1,650 patents and 3,200 patent summary cards on the development of synthetic rubber in the United States and Europe have been made available by the Office of Technical Services, United States Department of Commerce, Washington, D. C.

The collection, microfilmed in 1948, contains almost all patents produced during World War II and earlier by Germany, Britain, and France. Included are some basic Austrian patents and a number of U. S. developments of special interest. The summary cards are abstracts of the more significant French and British patents.

The patents were assembled by the Government Laboratories, operated by the University of Akron under contract to the National Science Foundation. Sets of the microfilms, with five reels to a set, may be ordered from Photoduplication Service, Publications Board Project, Library of Congress, Washington 25, D. C. Order number is PB 120575. The price is $20 a set.

New General 14-Inch Tire

The first in a new line of 14-inch tires has been announced by The General Tire & Rubber Co., Akron, O. The 14-inch wheel is generally expected to replace the 15-inch wheel in most 1957 automobiles.

Of tubeless construction, the General tire will weigh about one-half pound more than its 15-inch counterpart and have a larger cross-sectional girth. The greater width of the tread, together with lower air pressure, will give the tire improved tractive power and stability and a slower rate of wear, the company believes.

In making the announcement, L. A. McQueen, General Tire's vice president, said the company originated the 14-inch tire 25 years ago. Called the Jumbo 14, it held 12-16 pounds of air pressure, compared to the 32-36 pounds for the then used 17-inch-diameter tire. Recommended air pressure for the new 14-inch tire is 22 pounds, higher than the Jumbo 14 because of the greater loads of today's cars, Mr. McQueen declared.

Reveals Wooster Expansion

The Wooster Rubber Co., Wooster, O., will expand its facilities in Canada and at its Cleveland wire plant for production of its Rubbermaid housewares, according to James R. Caldwell, president of the firm.

A plant at Cookesville, Ont., Canada, will be erected to compound and mold the rubber houseware. These goods have until now been shipped to Canada from the company's Wooster facilities.

The firm's Port Credit, Ont., operations involving the production of vinyl-coated wire housewares will be shifted to the new plant when it is completed.

Wooster's wholly owned wire fabricating plant, Mid-West Metallic Products, Inc., Cleveland, O., will get a new building on a recently purchased 40-acre tract of land, Mr. Caldwell also said.

Fred G. Tweed

Fredericks Corp. Expands

Robert M. Fredericks Corp., Woodside, N. Y., has expanded its rubber operations to include Federal Rubber Mfg. Division, a new rubber molding plant specializing in prototype work, as well as production runs, in natural, synthetic, and silicone rubber products, the company reveals. Fredericks Corp. is a producer of die cut parts of all types and materials.

Fred G. Tweed has been appointed manager of the new plant.

FMSI Officers Elected

The Friction Materials Standard Institute, Inc., New York, N. Y., has elected Leo S. Sullivan, Russell Mfg. Co., president, and William J. Vachout, Carlisle Corp., vice president, for the year beginning July 1.

Among those also elected were Franklin A. Miller, Raybestos-Manhattan, Inc., and George S. Lamson, Thermoid Co., who will serve as members of the board of directors.

Miss Harriet G. Duschek, is secretary of the organization.

UCC's L-41 in Production

L-41 DiEthyl Silicone Oil, used in the preparation of a rubber and plastic mold release agents, is being made available on a commercial scale by the silicones division of Union Carbide & Carbon Corp., New York, N. Y.

The wider availability of the product, which has been sold in development quantities for the past few years, is a result of UCC's new silicones plant at Long Reach, W. Va., going into full production, the company revealed.

L-41 is more useful than the company's better-known DiMethyl Silicone Oils because of its greater solubility in organic chemicals, and its permitting painting, gluing, or inking operations on the moldings, according to Union Carbide.

Approve Financing Scheme

Stockholders of United States Rubber Co., New York, N. Y., have added convertible debentures to the types of securities which the company's board of directors may issue. Authorization was in the form of an amendment to the firm's certificate of organization.

The issuance of debentures convertible into common stock is one of several possible methods the company has been considering for raising 50 to $60 million which may be needed for plant expansion and working capital, H. E. Humphreys, Jr., chairman explained.

If U. S. Rubber should increase its debt by $60 million this year, total long-term debt would then be $238 million, Mr. Humphreys revealed. That would be nearly $210 million greater than the company's debt 10 years ago.

He also announced that, if convertible debentures are issued, they will be offered pro rata to holders of the common stock, as provided by the General Corporation Act of New Jersey, under which the company is incorporated.

Resin 510 Produced Again

Resin 510 has again been put into production at the Bauer, Utah, plant of R-B-H Dispersions division of Interchemical Corp., Bound Brook, N. J. The plant was destroyed by fire last September and has since been rebuilt, to twice its former capacity, the company says.

An odorless and tasteless form of Resin 510, Resin 529, is also being made for use in adhesives, sealants, and other compounds in the food industry.

Resin 510 has been used in oleoresinous varnishes and primers, cold cut vehicles, synthetic rubber adhesives, and asphaltic laminates, and as an extender or modifier with elastomers, chlorinated rubber, and vinyls.

Both resins are fossil resins mined in Utah where they are found in clear, yellowish flakes as a 2-5% component in certain large coal deposits. Resin 510 is a 98% hydrocarbon with a molecular weight around 800, iodine value of 140-150, pH of 6 4-6.7, and a melting point of about 180° C.

Alcoa Tubeless Tire Wheel

A forged disk aluminum wheel for tubeless truck tires, called the nation's first, has been placed on the market by Aluminum Co. of America, Pittsburgh, Pa. The one-piece 22.5- by 7.50-inch wheel has a lighter unsprung weight than conventional wheels.

According to the company, the wheel's lightness and high thermal conductivity result in easier steering, smoother riding, lower maintenance costs, and cooler-running and longer-lasting tires. Truck payloads are higher.

Other advantages of the aluminum wheel are said to be easier tire changes, the providing of maximum brake drum clearance, and rustproofness.

News About People

Charles J. Harrington, assistant sales manager for isocyanates in the elastomers division of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has been named assistant director of sales for the division, succeeding **Oliver M. Hayden,** who was appointed special assistant to the director of sales.

Lewis J. Pentland, Evan E. Graham, and **Henry B. Puff** have been promoted to district sales managers for New York, California, and Chicago, respectively, in the Durez Plastics Division of Hooker Electrochemical Co., Niagara Falls, N. Y.

J. W. Keener and **Arthur Kelly** have been elected executive vice presidents of The B. F. Goodrich Co., Akron, O.; while **Joseph A. Hoban** and **E. F. Tomlinson** have been elected vice president of marketing for Goodrich and president of B. F. Goodrich Tire Co., respectively. Mr. Keener has served as a vice president of Goodrich since 1946. Mr. Kelly has been a vice president of the company and president of Goodrich Tire since 1953, the year Hoban and Tomlinson were named vice presidents of Goodrich Tire.

John W. McGovern has been elected executive vice president of United States Rubber Co., New York, N. Y., succeeding **H. Gordon Smith,** who will retire after 39 years of service with the company, but who will continue as a member of its board of directors. Mr. McGovern, who joined the company in 1920 as an accountant, was also elected vice chairman of the executive committee.

Anthony Mack

John W. McGovern

William B. Flora, manager of B. F. Goodrich Store Administration, Akron, O., has been appointed vice president-sales of B. F. Goodrich Canada, Ltd., Kitchener, Ont.

Riley P. McGlothlin has joined Mobay Chemical Co., St. Louis, Mo., as personnel supervisor for the firm's administrative offices.

Arthur Solgas has joined Controlled Rubber Products, Inc., Willoughby, O., as production manager. He was formerly with Thompson Products, Inc.

J. W. Keener

Fabian Bachrach

Arthur Kelly

John A. Gannon and **Murray H. Reich** have joined the polymerization section, plastics and polymers department, at the new central research laboratory of the chemical divisions of Food Machinery & Chemical Corp., Princeton, N. J. Also joining the laboratory staff as research chemists are **Gino R. Treves** and **Charles deThan,** who will serve in the organic chemistry department and the polymer evaluation section of the plastics and polymers department, respectively.

William R. Tonge has been named technical manager of de-icers and aeronautical accessories for The B. F. Goodrich Co., Akron, O., succeeding **Charles S. Stebbins,** who has been transferred to B. F. Goodrich International Co.

Paul Beebe, Sr., has been placed in charge of foreign operations compounding for The Goodyear Tire & Rubber Co., Akron, O. Formerly with Nippon Goodyear KK, Kurume, Japan, Mr. Beebe has been associated with Goodyear for 40 years.

Paul Beebe, Sr.

L. R. Kilpatrick, manager of airship envelope development for The Goodyear Tire and Rubber Co., Akron, O.; **J. F. Purdy,** tire mathematician; **E. T. Duke,** in charge of camelback and repair materials; and **G. W. Rye,** designer, have received the company's Dinsmore Merit Award for "outstanding technical achievement in 1955."

Merritt W. Wolfe has been appointed chief engineer in charge of tube and accessory design for The Goodyear Tire & Rubber Co., Akron, O., succeeding **Boyd C. Eberhard,** who has retired after 43 years with the company.

W. H. Millett and **M. A. Bigelow** have been appointed sales manager and assistant sales manager, respectively, of Ucon products for Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y.

Paul Mayfield, a director of Hercules Powder Co., Wilmington, Del., has been elected a vice president and a member of the company's executive committee. **J. B. Johnson,** a vice president, has resigned from the executive committee, but will continue as a director. **G. Fred Hogg** and **John H. Long** have been named general manager of the firm's naval stores department and paper makers chemical department, respectively.

Ted M. Kersker, chief textile engineer for the Goodyear Tire & Rubber Co., Akron, O., has been named manager of fabric development for all of the company's tire divisions.

Milton D. Lange

Milton D. Lange has joined the carbon black and pigment division of Columbian Carbon Co., New York, N. Y., as manager of the Monroe, La., sales office. He was formerly associated with Armstrong Tire & Rubber Co., Mellon Institute of Industrial Research, and The B. F. Goodrich Co.

John L. Miller has been named director of defense activities for The Firestone Tire & Rubber Co., Akron, O., and is succeeded as manager of the defense research division by **George R. Thurman,** formerly assistant manager of the division. Dr. Miller joined Firestone in 1941 as chief metallurgist.

Robert W. Jaeger has been appointed general manager of ARco Rubber Processors, Houston, Tex., division of Automotive Rubber Co., Inc., Detroit, Mich. He replaces **Richard D. Bailey,** who has been advanced to general lining superintendent of all ARco divisions, with headquarters in Detroit.

Dwight B. Eib has been appointed assistant director of industrial relations for The Firestone Tire & Rubber Co., Akron, O., and is succeeded as industrial relations manager of the company's Pottstown, Pa., plant by **Henry N. West,** assistant industrial relations manager there.

Ankers Photographers

J. York Welborn

J. York Welborn, for the past 25 years associated with the United States Bureau of Public Roads, has been appointed director of the Natural Rubber Bureau research laboratory, Washington, D. C.

George Deurell, Jr., has been appointed operating manager of the shoe products division of The Goodyear Tire & Rubber Co.'s Windsor, Vt., plant. He is succeeded as manager of merchandise control for the plant by **W. W. Weddell,** formerly section head in the merchandise distribution department.

G. Lupton Broomell, Jr., has been made assistant director of engineering, acting head of engineering and inspections departments, and member of the executive operating committee of Leeds & Northrup Co., Philadelphia, Pa. He succeeds **John W. Harsch,** who is retiring.

A. Eugene Schubert has been named manager of the chemical development department of General Electric Co., Pittsfield, Mass. Formerly manager of engineering for the company's chemical materials department, Dr. Schubert has done pioneering research in the field of silicones and assisted in the planning of G-E's Waterford, N. Y., silicone plant.

John W. Warner and **Gordon H. Campbell** have been promoted to manager and assistant manager, respectively, of the coatings department of The Goodyear Tire & Rubber Co., Akron, O. **Charles S. Baker, III,** has been made special representative to the Charlotte, N. C., sales area for the department.

H. B. Coleman and **J. G. Hendricks** have been named regional managers of the northeastern and southwest sales areas, respectively, for the industrial wholesalers division of The Dayton Rubber Co., Dayton, O. Joining the division's sales staff are **Hampton Harris, Ross Annatoyn, John Morgan, Ed Wallace,** and **Al Herman.**

J. M. Linforth, vice president in charge of manufacturers', government, and aviation products for the Goodyear Tire & Rubber Co., Akron, O., has retired after 33 years of service with the company. His achievements include the organization of the firm's highway transportation department in 1924 and the development of a worldwide over-the-road tire sales organization for Goodyear Export Co. in 1927.

Colin M. Ford, Jr., has been appointed assistant manager of Seiberling Rubber Export Co., Akron, O.

Maynard H. Patterson has been advanced to vice president and general manager of the international division of Minnesota Mining & Mfg. Co., St. Paul, Minn.; while **Kenneth J. Shea** has been promoted to vice president and general manager of the company's Canadian subsidiary.

Leon Breton has been appointed manager of market research and development for American Mineral Spirits Co., Chicago, Ill. Before joining the firm he had been associated with Enjay Co., where he worked in the marketing of chemicals.

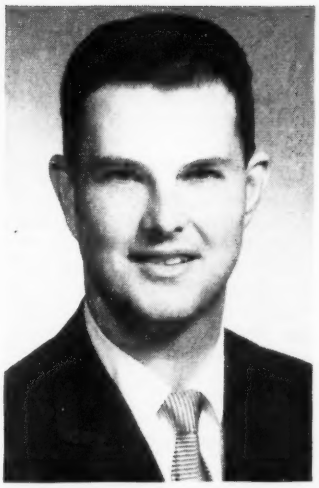
Daniel L. Pellett

Daniel L. Pellett, manager of the engineering design department of The B. F. Goodrich Co., Akron, O., has been appointed director of engineering services.

Richard A. Steenrod has been appointed a materials engineer for the silicone products department of General Electric Co., Waterford, N. Y. He joined the company in 1950.

Robert Allen has been named consultant on machinery sales for Crown Cork & Seal Co., Inc., and will headquarter in Baltimore, Md.

Norman Nuttall has rejoined Stein, Hall & Co., Inc., New York, N. Y., as manager of its Charlotte sales branch, replacing **Frank Perry,** who has become manager of the company's domestic starch department.



Gilbert D. Gingold

Thoburn P. Sands and **William B. Hicks** have been promoted to section managers in the development department of the organic chemicals division of Monsanto Chemical Co., St. Louis, Mo.

Edward E. Stritter has joined Chase & Sons, Inc., North Quincy, Mass., as chief chemist. He was formerly chief compounder for hose and belting for Boston Woven Hose & Rubber Co.

Ralph W. Sohl, chief engineer for the agricultural tire development department of The Goodyear Tire & Rubber Co., Akron, O., has retired after 37 years of service with the company.

U. T. Greene, coordinator of the commercial development department of Diamond Alkali Co., Cleveland, O., has been appointed director of the chemical and rubber division, Business & Defense Services administration, United States Department of Commerce. Appointed in July, Dr. Greene will serve in the position until January, 1957.

U. T. Greene

J. R. Keach, former vice president of Thermoid Co., has joined Sid Richardson Carbon Co., Fort Worth, Tex., as sales manager, succeeding **F. A. Bonstedt,** who is retiring but will continue to serve in a consulting capacity. **Gilbert D. Gingold,** formerly with The Goodyear Tire & Rubber Co. and with Naugatuck Chemical Division, United States Rubber Co., has also joined Sid Richardson as special sales representative. Both Mr. Keach and Mr. Gingold will headquarter in Akron, O.

J. R. Keach

Emanuel Singer, H. Kramer & Co., Chicago, Ill., has been named chairman of the forty-fourth annual convention of the National Association of Waste Material Dealers, Inc., to be held March 10-12 in Chicago.

George S. Ketter has been named manager of engineering design for The B. F. Goodrich Co., Akron, O. He joined the company in 1946.

Robert W. Laundrie has been named chief process chemist in charge of process engineering at the Mogodore, O., plant of the chemical division of The General Tire & Rubber Co., Akron, O. Also appointed at the plant are **Louis E. Gressingh,** to process engineer; **John M. Gyenge,** to rubber technical service chemist; and **Robert W. Kreider,** to paint chemist.

L. E. Rabjohn has been promoted to West Coast division manager, Firestone Industrial Products Co., Akron, O., for Firestone Foamex. He will headquarter in Los Angeles, Calif.

William B. Fitzmaurice has been named industrial division sales representative in the New England area for Tracerlab, Inc., Boston, Mass.

Richard C. Ten Eyck has been promoted to manager of tank lining and industrial rubber covered roll sales department of The Goodyear Tire & Rubber Co., Akron, O. He succeeds **R. M. Junker,** resigned.

Carl Mullen

Carl Mullen has been appointed a member of the board of management of Gates Rubber Co., Denver, Colo. He is vice chairman of the SAE-ASTM technical committee "A" on automotive rubber and chairman of the Ordnance Advisory Committee on hose products.

George H. Hotte, director of fiber sales and service for National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y., has been named by The Textile Institute of Manchester, England, convener of its American panel.

Boyd C. Eberhard, chief engineer in charge of tubes and accessories at the Goodyear Tire & Rubber Co., Akron, O., has retired after 46 years of service with the company. He is credited with helping the development of Goodyear's new Captive-Air safety tire.

Wilbur V. Keegan has joined Carbon Dispersions, Inc., Newark, N. J., by purchase of stock and, as vice president, will engage in technical and sales development.

Wilbur V. Keegan

Robert Moran has been advanced to manager of defense and new products sales for The General Tire & Rubber Co., Akron, O., succeeding **R. H. Mallory,** who has been promoted to general manager of The General Tire & Rubber Co. of Canada, Ltd., Toronto, Ont.

H. J. Barich, Seamless Rubber Co.; **J. H. Gibson,** Pioneer Rubber Co.; **R. B. Little,** Davol Rubber Co.; and **Charles H. Wyer,** A. W. Faber-Castell Pencil Co., were elected to serve on the executive committee of the Sundries Division of the RMA at the annual meeting of that division at the Hershey Hotel, Hershey, Pa., during June.

Theron J. Thaden has been named chief engineer, agricultural tire development, for The Goodyear Tire & Rubber Co., Akron, O., succeeding **R. W. Sohl,** who has retired after 37 years with the company.

Thomas Barker has been appointed manager of special products sales for American Mineral Spirits Co., Chicago, Ill., assuming some of the responsibilities of **Martin B. Chittick,** who will retire in 1957.

R. F. Teeling has been made manager of the eastern sales region for Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J., and **J. T. M. Frey** has been named manager of the eastern region's North Jersey district.

J. L. Krouse has been assigned to the special products department of The Goodyear Tire & Rubber Co.'s industrial products division, Akron, O., where he will handle sales of electrostatic air filters. He replaces **E. F. Poling,** who has resigned.

Miss G. Florence Burton and **Carlo J. Verbanic** have joined the technical staff of Hooker Electrochemical Co., Niagara Falls, N. Y., and will serve in the physical chemistry section of the analytical group and in polymers research, respectively.

Hjalmer Lundquist, who retired as chief design and tool engineer of National Vulcanized Fibre Co., Wilmington, Del., will continue to serve as an engineering consultant.

Daniel R. Elliot and **Seymour A. Lippmann,** United States Rubber Co., tire engineering and research group, Detroit, Mich., recently received recognition for their work on tires and tire materials by election to the Detroit chapter of Sigma Xi, national honorary engineering fraternity.

Philip W. Drew has been placed in charge of all development phases dealing with the new Captive-Air safety tire by The Goodyear Tire & Rubber Co., Akron, O. Drew, with the company in engineering more than 30 years, most recently served as manager of fabric development.

Kenneth W. Ericson

Kenneth W. Ericson has joined Whittaker, Clark & Daniels, Inc., New York, N. Y., and will serve in sales development and promotion of the company's colors. He was formerly general sales manager of Titanium Pigment Corp.

W. E. Brimer, Tyer Rubber Co., was elected to the executive committee of the Footwear Division of The Rubber Manufacturers Association, Inc., at the annual meeting of the Division at the Mountain View House, New Hampshire, in June. Mr. Brimer succeeds **Charles H. Baker,** Goodyear Footwear Corp., who resigned after many years of service on this committee. Reelected to serve on the committee were **J. S. Barrie,** Hood Rubber Co. Division, B. F. Goodrich Co.; and **E. A. Luxenberger,** United States Rubber Co.

News Briefs

Firestone Plastics Co. and Foamex Division of **Firestone Industrial Products Co.,** both divisions of The Firestone Tire & Rubber Co., Akron, O., have opened a new combined Chicago sales office at the Merchandise Mart, Suite 950, Chicago, Ill.

New Jersey Zinc Co., New York, N. Y., has dissolved its subsidiary, New Jersey Zinc Sales Co., whose functions will now be handled by the sales department of the parent company.

The B. F. Goodrich Co., Akron, O., is boosting by 50% output at its Los Angeles, Calif., tire plant, with the installation of new passenger-car tire presses.

Armstrong Rubber Co., West Haven, Conn., has placed on the market a tire with a white sidewall compounded with a small amount of Du Pont's "Hypalon." In road tests in the Los Angeles, Calif., area, where the ozone concentration is particularly high, no discoloration or cracking has been observed long after white sidewalls without "Hypalon" showed this characteristic service failure.

Wyandotte Chemicals Corp., Wyandotte, Mich., will build a multimillion-dollar ethylene oxide manufacturing plant 25 miles south of Baton Rouge, La. Ethylene oxide is used in the production of such chemicals as acrylonitriles, glycols, and ethanol amines.

Advance Solvents & Chemical, Division of Carlisle Chemical Works, Inc., has moved its executive and sales offices to 500 Jersey Ave., New Brunswick, N. J.

Pennsylvania Industrial Chemical Corp., Clairton, Pa., has opened a sales residency in Cleveland, O., with Gardner L. Brown in charge.

The Goodyear Tire & Rubber Co., metal products division, Akron, O., has introduced a single-type rim valve that is said to eliminate 16 dfferent valves previously required.

Monsanto Chemical Co., plastics division, Springfield, Mass., has tripled its capacity to produce vinyl chloride paste resin.

Texas Co. and **New Jersey Zinc Co.,** both of New York, N. Y., have jointly purchased the Happy Jack Mine in Utah from Bronson & Cooper Mining Co. The mine contains uranium ore.

Hewitt-Robins, Inc., Stamford, Conn., has chosen the trade name Hewitex to designate its urethane foam.

Stauffer Chemical Co., New York, N. Y., will absorb West End Chemical Co., Oakland, Calif., producer of borax, soda ash, salt cake, and lime at its Searles Lake, Calif., plant. West End will operate as a division of Stauffer.

National Safety Council, Chicago, Ill., has reported that the accident frequency rate in the rubber industry during 1955 fell 12% below the 1954 figure; the severity rate was unchanged. The frequency and severity rates in the chemical industry dropped 22 and 9%, respectively.

Borden Co., New York, N. Y., will begin operations at a new polyvinyl acetate polymerization plant at Demopolis, Ala., on August 1. The facilities, under the supervision of the Polyco-Monomer department of Borden's chemical division, will have an initial annual production of 10 million pounds.

Aceto Chemical Co., Inc., Flushing, N. Y., has opened a West Coast office at 6850 Tujunga Ave., North Hollywood, Calif.

Harchem Division, Wallace & Tiernan, Inc., Belleville, N. J., has opened a new eastern shipping and storage depot at Belleville for its Century Brand oleic acid.

Hydraulic Equipment Co., Los Angeles, Calif., has been appointed distributor of Asco solenoid valves by Automatic Switch Co., Orange, N. J.

Vansul & Co., Englewood, N. J., has appointed Columbian Carbon, Ltd., Toronto, Ont., Canada, exclusive Canadian distributor of its color pigments and dispersions.

General Aniline & Film Corp., New York, N. Y., has added a long-range planning section to the commercial development department of its chemical division. Albert Bloom has been appointed manager of plannings for the new section.

Lord Mfg. Co., Erie, Pa., has opened a new field office in the Statler Office Bldg., Boston, Mass., under the direction of John A. Bowler; and one at 1507 Brookpark Rd., Cleveland, O., under the direction of Robert A. Alexander.

Financial

Allied Chemical & Dye Corp., New York, N. Y. First half, 1956: net earnings, $25,519,092, equal to $2.65 a share, against $26,523, 965, or $2.77 a share, in the 1955 period.

Collins & Aikman Corp., New York, N. Y. June half, 1956: net loss, $167,735, contrasted with net profit of $400,779 in the like period last year.

Diamond Alkali Co., Cleveland, O. June half, 1956; net earnings, $5,550,271, equal to $2.11 a common share, compared with $1.53 a share, in the same period last year; net sales, $61,609,242, against $53,660,322.

American Cyanamid Co., New York, N. Y., and subsidiaries. June half, 1956: net earnings, $33,129,467, equal to $3.29 a common share, compared with $17,419,-858, or $1.94 a share, in the June half of 1955; net sales, $252,885,119, against $225,357,253.

The Eagle-Picher Co., Cincinnati, O. Six months to May 31, 1956: net profit, $3,677,627, equal to $3.65 a share, compared with $2,086,942, or $2.11 a share, in the like period last year; net sales, $58,-999,627, against $55,750,648.

Hooker Electrochemical Co., Niagara Falls, N. Y., and wholly owned subsidiaries. Six months to May 31, 1956: net earnings, $5,743,400, equal to 94¢ a common share, against $5,121,400, or 83¢ a share, a year earlier; net sales, $49,658,200, against $46,540,100.

Hercules Powder Co., Wilmington, Del. First half, 1956; net income, equal to $1.18 a common share, against $1.13 a share in the '55 half; sales, $120,433,778, against $112,562,077.

Parke, Davis & Co., Detroit, Mich. First half, 1956: net earnings, $8,633,950, equal to $1.76 a share, compared with $6,393,-863, or $1.31 a share in the 1955 months.

Sun Oil Co., Philadelphia, Pa. January 1-June 30, 1956: net earnings, $25,138,552, equal to $2.53 a common share, against $24,407,336, or $2.48 a share, in the like period last year.

A. G. Spalding & Bros., Chicopee, Mass. Six months to April 30, 1956: net earnings, $155,000, equal to 27¢ a share, contrasted with $320,000, or 59¢ a share, in the like period last year.

CALENDAR OF COMING EVENTS

August 26-30
Natl. Assn. of Furniture Mfrs. Supply, Equipment & Fabric Fair. Conrad Hilton Hotel, Chicago, Ill.

September 8
Connecticut Rubber Group. Outing.

September 9-12
American Institute of Chemical Engineers. William Penn Hotel, Pittsburgh, Pa

September 10-12
American Society of Mechanical Engineers. Fall Meeting. Denver, Colo.

September 16-22
American Society for Testing Materials. Pacific Coast Meeting. Los Angeles, Calif.

September 19-21
Division of Rubber Chemistry, ACS. Chalfonte-Haddon Hall, Atlantic City, N. J.

September 27
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

September 28
Chicago Rubber Group.

October 2
The Los Angeles Rubber Group, Inc. Hotel Statler, Los Angeles, Calif.

October 5
New York Rubber Group. Fall Meeting. Henry Hudson Hotel, New York, N. Y.
Boston Rubber Group. Fall Meeting. Hotel Somerset, Boston, Mass.

October 22-26
National Safety Council. Forty-Fourth National Safety Congress and Exposition. Chicago, Ill.
(Rubber Section, October 22-23.)

October 26
Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa.

October 30
Buffalo Rubber Group.

November 2
Chicago Rubber Group.

November 8
Rhode Island Rubber Club. Fall Meeting. Pawtucket Country Club.

November 8-9
National Research Council of Canada and Chemical Institute of Canada. Seventh Canadian High Polymer Forum. Guildwood Inn, Pt. Edward, Ont., Canada.

November 16
Connecticut Rubber Group.

November 25-30
American Society of Mechanical Engineers. Annual Meeting. Hotel Statler, New York, N. Y.

November 26-30
Twenty-Second National Exposition of Power & Mechanical Engineering. Coliseum, New York, N. Y.

November 27-30
Cleveland and Chicago Sections, ACS. Ninth National Chemical Exposition. Public Auditorium, Cleveland, O.

November 28-30
International Ozone Conference. Sheraton Hotel, Chicago, Ill.

December 5
Buffalo Rubber Group. Christmas Party.

News from Abroad

Around the Rubber World

By L. Thakar

(This discussion of the Indonesian rubber scene by RW foreign news editor supplements the on-the-spot series of reports on the rubber industry in the Far East which was concluded last month.)

Tokyo, Japan. Unable to get to Indonesia, I paid a visit to the INIRO Tokyo office, the Japanese branch of the INIRO (Indonesian Institute of Rubber Research), of Bogor, Indonesia. The organization is now officially called Jajasan Penjelidikan dan Pemakaian Karet, but is usually referred to as J. P. & P. Karet.

INIRO Tokyo, founded five years ago, does no research, but concentrates on development work, although it hopes to have its own laboratory shortly. It maintains close contact with the Japanese rubber industry, keeping it posted on technical developments at Welwyn, the Rubber Stichting, the I.F.C. in Paris, and the Bogor institute, and giving advice and aid.

Indonesian Replanting

S. Narusawa, its director, told me that huge areas of rubber plantings in Indonesia were reaching old age, and that the declining yield would contribute to the expected fall in rubber production in the Far East. He reminded me that the cumulative effect of large-scale replanting in Malaya would affect output by rendering many sections temporarily unproductive. A similar situation would come into being in Indonesia when the government institutes its own replanting scheme.

Mr. Narusawa agreed that there are untapped areas, in Sumatra, but he discounted them in Indonesia's potential output because they are in the more inaccessible districts. My own impression is that with sufficient inducement these areas might still be opened up and therefore should not be wholly overlooked.

Experts have visited Malaya to study the replanting system for small-holdings and have come up with a scheme of their own. Actually, Indonesia offers more opportunities for replanting and new planting of rubber than any other country, but the great obstacle is financing.

It is proposed to replant 260,000 hectares (a hectare is about 2.45 acres) of smallholder rubber, which is 20% of the total area of 1,300,000 hectares. The replanting would take place over a 10-year period, to end December, 1965.

Most of the smallholdings are in Sumatra, and almost 50% of the total rubber-growing area for all Indonesia is concentrated in the three Sumatran provinces of Palembang (322,000 hectares), Djambi (188,000 hectares), and Tapanuli (107,000 hectares). Next come Southeast and West Borneo, which together make up almost 25% of the total, or 317,400 hectares.

Djambi, in particular, needs replanting, according to Mr. Narusawa. There the average age of the gardens is 30 years, and the yields have been falling away. Last year, to take advantage of the high prices, the trees were over-tapped, but the low yields expected this year will be the price paid for this forced output.

Production on estates, too, is expected to decline. This condition is a direct result of minimal replanting, as well as damage done to trees by illegal tappers and squatters.

There are many factors in the current Indonesian scene to discourage estate owners from replanting. Social unrest pervades the islands, and various political factions are engaged in a bitter struggle for power.

The foreign estate owners want legal security from the government before undertaking replanting schemes. They expect guarantees for continued operation, including renewal of land leases and protection against squatters. They also want protection from what they consider the unfair demands and practices of the labor unions. Labor productivity and discipline are unsatisfactory and combined with the frequent wage increases have led to a substantial rise in the cost of production. Many workers are incompetent, but cannot be fired because of the unions.

If the government has been lax in aiding the estates, they have shown eagerness in helping smallholders. An attempt to improve the quality of smallholder rubber has been made, following previous plans of the ousted Dutch authorities. Smallholders have also been urged to make sheet instead of slab rubber, since most of the profit in slab production goes to dealers and remillers.

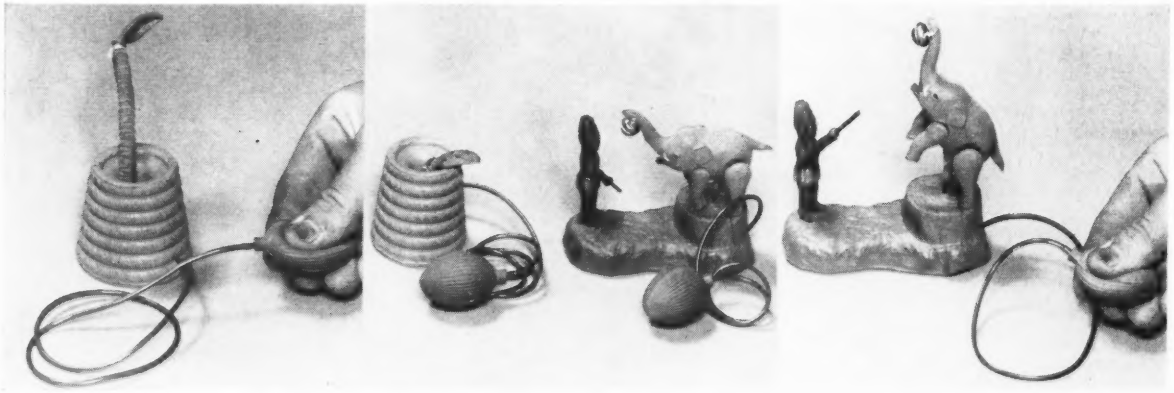
Remilling Plants

Notwithstanding, a large amount of slab continues to be produced and exported to Singapore for remilling. As a secondary measure to benefit the home economy, the government is trying to divert the slab to the 17 local remilling plants, which support about 7,000 workers and their families. Dealers have resisted these efforts, some preferring to store slab stocks, hoping to sell them eventually to Singapore remillers at greater profit.

The capacity of Indonesian remilling plants was greatly increased after the war and is now believed to be at least 307,000 tons. This is far in excess of actual requirements, it is said, and the government is being urged to limit construction of new remilling plants and in general to take a greater legal interest in the industry. Research to improve the quality of the remilled rubber is going on at Bogor.

C. D. Crepe

Recently, coagulum dialyzed crepe was developed at Bogor by Prof. Th. G. F.



Two interesting rubber toys from the Kinugawa Rubber Industrial Co., Ltd., Tokyo, Japan, obtained by our foreign news editor during a recent visit in that area

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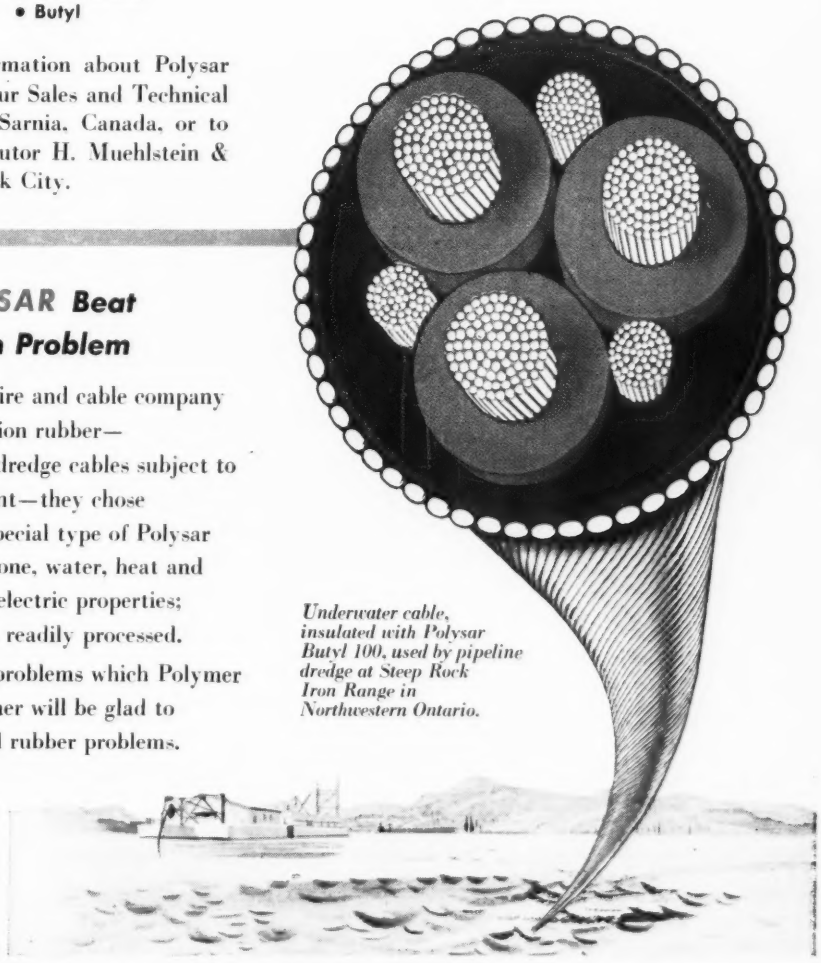
When a large Canadian wire and cable company was looking for an insulation rubber—to be used in underwater dredge cables subject to extremely rugged treatment—they chose Polysar Butyl 100. This special type of Polysar gives high resistance to ozone, water, heat and cold; provides excellent dielectric properties; has good flexibility, and is readily processed.

This is only one of many problems which Polymer has helped to solve. Polymer will be glad to help you with your critical rubber problems.



Underwater cable, insulated with Polysar Butyl 100, used by pipeline dredge at Steep Rock Iron Range in Northwestern Ontario.

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Schoon, head of the research department of J. P. & P. Karet, as a result of studies on enzymes in latex made by Mrs. L. N. S. de Haan-Homans.

The C. D. Crepe is prepared from coagulum that has been deproteinized by soaking it in running water for two to three weeks. The crepe is said to have superior insulation properties, making it valuable for electrical insulations. It also can be employed for producing colored goods and for odorless piping, such as used by breweries. The crepe, however, has not yet appeared on the commercial market.

Malaya

Red China Export Approved

Malayan rubber men have finally got their wish—something has been done to ease the ban on rubber exports to Red China. Reasonable amounts of rubber may now be shipped under license if authorities are satisfied that the rubber is intended for civilian purposes. Many find the limitations irksome, and in some quarters there is a tendency to look forward to the day when Malaya is independent, and the rubber industry can do what it pleases. The news, however, was welcome and greeted with varying degrees of satisfaction according as individual producers and dealers saw in freer trade with China a cure for practically all the afflictions of the industry, took a moderately optimistic view of immediate and long-term results, or considered the measure chiefly important for its psychological effect.

The president of the Singapore Rubber Association saw China buying large quantities of rubber to meet the needs of her growing communications systems and light and heavy industries, which would result in sending the price of rubber at least back to $1.20 (Straits) per pound, in stabilizing Malayan economy, raising its standard of living, and boosting government revenue. The general opinion seemed to be that for the time being, at any rate, China was not likely to buy more than a few thousand tons from Malaya because of commitments to Ceylon and because she seems to have practically all the rubber she requires for this year.

Meanwhile Indonesia seems to have decided to lift the embargo on rubber to China so that, all in all, the latter is in an excellent bargaining position. In this connection it is learned that the 45,000,000 rupees China still owed Ceylon on the rubber rice deal was recently paid off in Sterling.

Malayan optimism over the removal of the ban is undoubtedly in large part due to the fact that for the first time in many a year there is a prospect that the balance of trade with China may be favorable to Malaya, or at least less unfavorable than it has been. For a long time now China has been selling much more to Malaya than she has been buying. In 1955 she sent various kinds of goods—chiefly fresh fruits, nuts, vegetables and other foodstuffs, cotton fabrics, pens, jewelry, paper board, and numerous other items, to a total value of $115,700,000 (Straits) and took from Malaya products—mainly coconut oil—valued at only $12,800,000. Small wonder, then, that Malaya is anxious to sell China as much rubber as possible, and that members of the Chinese community have enthusiastically advocated sending technologists and other experts to Red China in order to help establish rubber factories there.

How much rubber China now actually requires is anybody's guess. In 1948 she bought 21,048 tons; in 1951, 73,250 tons; Ceylon supplied 56,323 tons in 1954, but in 1955, 32,349 tons were all China seemed to need. Now, of course, she can buy where she pleases; up to early July, however, she showed no disposition to go to Malaya for rubber.

Incidentally, it was recently reported in Singapore by visitors arriving from Red China that that country is growing rubber in the southern provinces, particularly Hainan. It seems possible that rubber growing in that area, said to have been attempted before World War II, has now been resumed.

Work at the R.R.I.

In a summary of the advisory work of the chemical division of the R.R.I. carried out in 1955, appearing in the May, 1956, issue of the *Planters' Bulletin*, it is stated that the most troublesome problems again related to latex concentrates. Producers are realizing more and more the dangers of contamination, and to meet the resulting increased demand for bacterial counts, a routine laboratory is being set up. Marked improvements have already resulted from more thorough cleansing. The volatile fatty acid test, though it does not indicate the presence of live bacteria, continues a valuable means of rapidly detecting putrefaction in latex.

Concentrates from latex obtained high up the trees in ladder tapping differ in mechanical stability from those from normal latices, sometimes showing an increase, and sometimes a decrease.

Patent applications have been made on three new preservative systems intended both for concentrates and for latex in field and factory. The systems are: low ammonia with antibiotics, low ammonia with sulfa derivatives, and low ammonia with boric acid.

Market demands and a shortage of firewood have stimulated interest in air-dried sheet, which incidentally often obtains a considerable premium over #1 RSS. Samples of sheet partly smoked and partly air-dried, which were examined, usually showed satisfactory properties. Brown sole crepe of satisfactory quality has been prepared by two factories by mixing skim rubber with the usual scrap and lump, thereby providing a posible outlet for skim rubber which does not infringe RMA Type descriptions.

In the March issue of the *Bulletin*, mention was made of the harmful effects of zinc deficiency in young seedling rubber; it stunts growth and makes the rubber very susceptible to *Oidium heveae*. It is suggested that where this disease is prevalent, the infected plants may be deficient in zinc.

Wage Dispute Ended

The long-drawn out dispute between management and labor over wages, that lasted almost three months, has been ended, for the time being at least, by a "stop-gap" agreement. The workers have not gained much by their uncooperative attitude, which went the length of calling a "go-slow" movement and numerous strikes. So far, they have not achieved a wage structure independent of the price of rubber. Wages will still be geared to price, but the price differential will be 20 cents instead of 10 cents. The workers get the same concessions offered by management before the go-slow movement—that is, seven more days annual leave for regular workers and time and a half for overtime. Male field workers will get five cents a day more than originally offered; before negotiations broke down, management had offered $2.85 a day, instead of the prevailing $2.30, for this class of workers. The Union held out for $3.00, but has now settled for $2.90. Tappers will get proportionate raises.

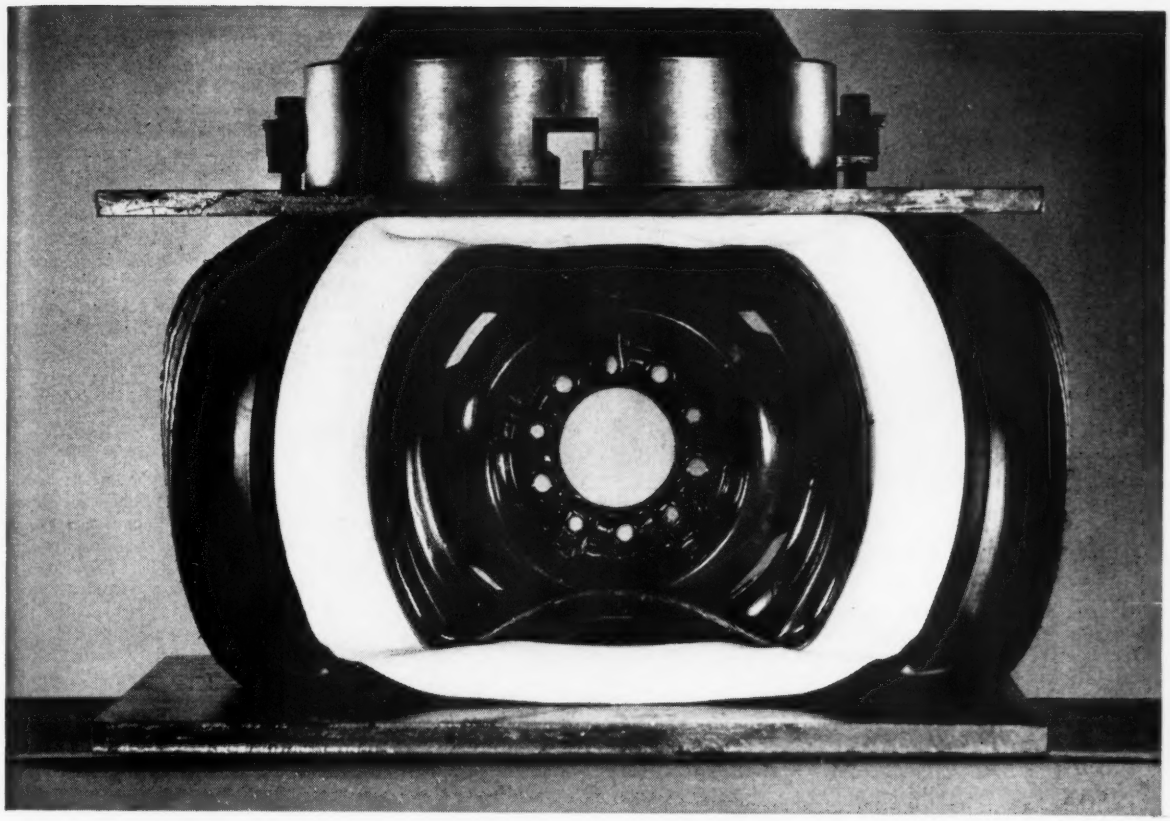
The slow-down—when workers refused to work on Fridays, to do overtime, or to tap wet panels—did not cause quite the losses to estates expected by the Union, but workers themselves suffered a loss in wages up to 25% on account of it. Output for May (when the slow-down was in force) totaled 43,092 tons, against 48,238 tons for April, with estates providing 23,389 against 26,591 tons, and smallholdings, 19,703 against 21,647 tons. Much of the decrease in crop on estates is ascribed to the very heavy rains in Malacca and Johore.

Now management and Union have agreed to bury the hatchet and to make a concerted effort to combat the threat of American synthetic rubber, and a technical committee has been set up by M.P.I.E.A. to make suitable recommendations. It is hoped to be able to work out methods leading to the production of more rubber, cleaner and better rubber, at a cheaper cost, while at the same time collective and individual benefits will be provided workers who cooperate to this end. The Union has said it is willing to back any "reasonable" measures.

Anti-Inflation Cess Refund

The government plans to return about $56,000,000 (Straits), collected as anti-inflationary cess on rubber, to the industry. A bill published in June provides for refunds to be made to estates in four quarterly installments. Since smallholders do not export directly, but sell to dealers, it is impossible to make individual refunds in their case; instead they will get a reduction in their replanting cess rates from 4½ cents to 2 cents a pound, until they have recovered all the money paid as anti-inflationary cess.

This cess, it may be recalled, was imposed in June, 1955, when the price was high, and then the government undertook to return the accumulated funds when the price of rubber again was low. The proposed refund has been widely welcomed by the industry; at the same time, it has been made clear in certain quarters that



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Sir Frank Beaurepaire, recently deceased chairman of Olympic Consolidated Industries, Ltd.

any attempt of government to reimpose the anti-inflationary cess will be fought, unless the price of rubber goes over $1.50 per pound (S.S. currency).

No Forward Contracts

The failing rubber market has caused a cessation in registration of forward contracts. Last October, when prices were rising, forward contract registration was introduced, with advance fixing of duty based either on the price ruling on the day of contract, or the day after registration, whichever was higher. The measure was intended to encourage forward selling and thereby help stabilize prices. As long as the market trend was upward, this worked; registered forward contracts were for 1,817,000 pounds in October, 3,418,426 pounds in November, and 3,404,800 pounds in December. But now, on a falling market, the possibility of having to pay a higher duty has in its turn discouraged forward selling.

Incidentally, the drop in rubber prices will result in a considerable deficit in government revenue. As the Minister for Finance put it, every 10 cents down in the price of rubber means a loss of $25,000,000 in revenue to the government.

Australia

Butt Succeeds Beaurepaire

Charles S. Butt has been elected chairman of Olympic Consolidated Industries, Ltd., Melbourne, Victoria, succeeding Sir Frank Beaurepaire, founder of the company, who died suddenly on May 29. Sir Frank's son, Ian Beaurepaire, has been named vice chairman.

Mr. Butt, wartime controller of rubber for the Australian Commonwealth Government, has been associated with the company since Olympic Tyre & Rubber Co. began manufacturing activities in Melbourne in 1934.

Ian Beaurepaire is general manager of the tire company. Thirty-three years old, he recently was elected a Melbourne City Councillor in the ward formerly held by his father, who was Melbourne's Lord Mayor from 1940 to 1942.

Sir Frank, a former world champion and Olympic Games swimmer, played a leading part in obtaining the 1956 Olympic Games for Melbourne and was expected to have been Melbourne's Lord Mayor for the Olympic Year.

Olympic Consolidated Industries has factories in Victoria and Queensland where tires, electrical cables, and other products are manufactured.

Sweden

1954 Production Up 17%

Sweden's output of the most important rubber articles in 1954 showed an overall increase, as compared with 1953 figures, of about 17% in quantity and 14% in value. The comparative amounts in the two years are in the table below.

In 1954 the rubber industry imported 28,683 tons of rubbers and solution, including 23,341 tons of natural rubber, 720 tons of synthetic rubber, 2,438 tons of natural and synthetic latices, 159 tons of sole crepe, and 1,130 tons of reclaim. Most of the natural rubber and latex came from Malaya; the United States supplied practically all the synthetic latex and—with an assist from Canada—practically all the synthetic rubber too.

Also imported were 7,832 tons of rubber manufactures, value at 57,721,000 kronor, the most important of which were tires for motor vehicles, 3,272 tons, value 18,290,000 kronor; mechanical goods, 1,267 tons, value 10,540,000 kronor; belting, 923 tons, value 7,944,000 kronor; foam rubber for upholstery purposes, 366 tons, value 2,633,000 kronor.

The United Kingdom and Ireland ranked first as suppliers of rubber goods to Sweden, sending 37% of the total quantity of rubber manufactures imported; Germany came next with about 23%. Britain led chiefly in tires and tubes for motor vehicles, and she also provided almost all the foam rubber; Germany was ahead in mechanicals, sanitary and surgical goods, and miscellaneous articles.

Sweden bought 14,096 tons of new rubber in the first half of 1955, against 14,537 tons in the corresponding period of 1954. On the other hand almost all imports of manufactures were above those in the 1954 period; belting, hose, and packing totaled 1,717 tons, against 1,299; tires for motor cycles and motor vehicles rose to 2,568 tons from 1,924; surgicals and sanitary goods, 282, against 214 tons; and other goods; 639, against 578 tons.

The trend of exports of rubber manufactures in the first half of 1955 varied as compared with the results of the 1954 period; there was a rise in mechanical goods exports, from a value of 378,000 kronor, to 517,000 kronor; footwear, from 491,000 to 623,000 kronor, and in other goods, from 2,907,000 to 3,648,000 kronor. This was offset by a drop in foreign sales of tires and accessories for motor vehicles and motorcycles, from 7,228,000 to 6,872,000 kronor in rubber-soled shoes, from 851,000 to 690,000 kronor.

		1953		1954	
		Quantity	Kronor	Quantity	Kronor
Cycle tires	*tons*	2,254	13,445,000	2,510	14,875,000
Tires for motorcycles and motor vehicles	*tons*	17,019	109,065,000	20,889	130,942,000
Cycle tubes	*tons*	527	3,080,000	675	3,955,000
Tubes for motorcycles and motor vehicles	*tons*	1,580	9,510,000	1,774	10,663,000
Rubber footwear	*thousand pairs*	4,957	48,694,000	5,521	52,623,000

Great Britain

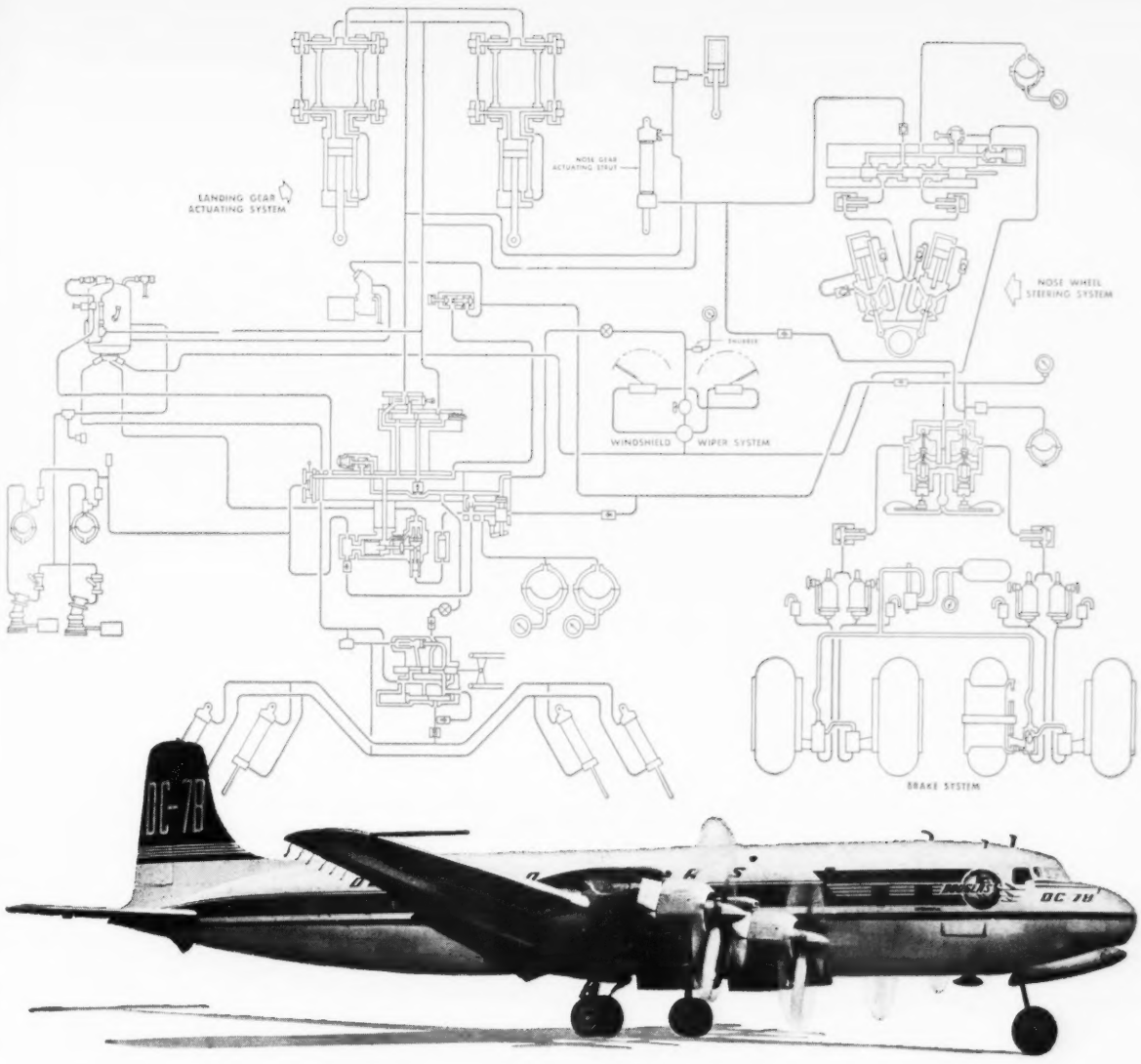
Five Papers at London IRI Vulcanized Rubbers Confab

An all-day symposium on "Comparative Properties of Vulcanized Rubbers" was held by the London Section of the Institution of the Rubber Industry, May 11, presided over by H. C. Baker. Five technical papers were presented to the 300 members in attendance.

L. Mullins discussed the shortcomings of laboratory tests for tear and abrasion resistance and gave data showing the effects of temperature and rate of tearing. The behavior of GR-S type and butyl rubbers was contrasted with that of natural rubber.

E. G. Williams discussed the behavior of various polymers at high temperatures and emphasized the long-term effects re-

(Continued on page 786)



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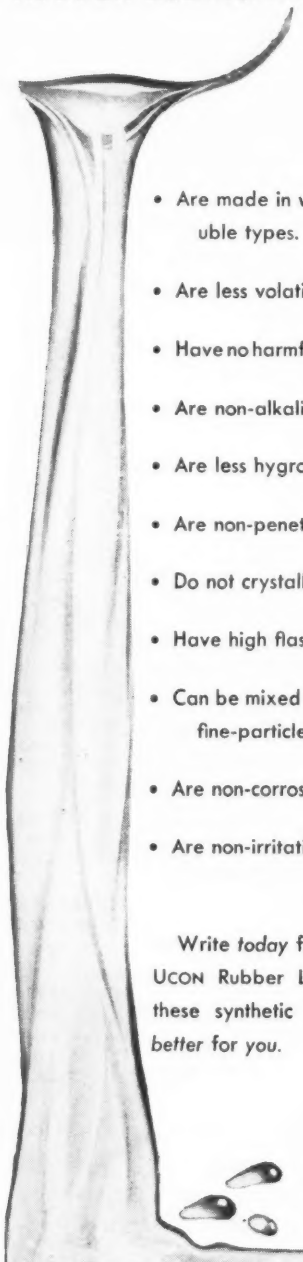

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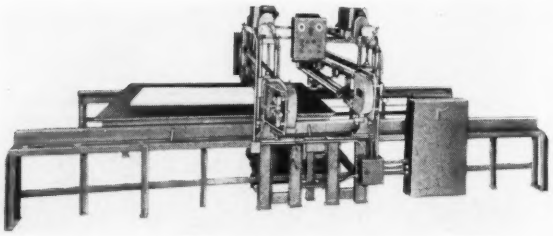
NEW EQUIPMENT



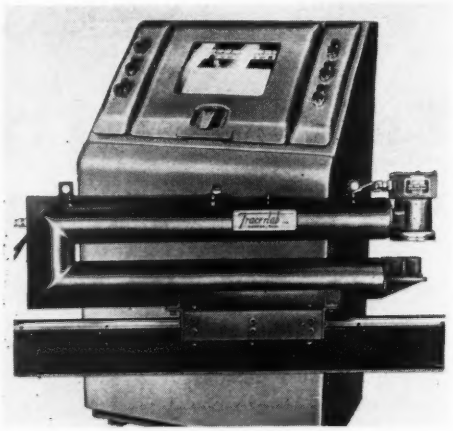
FEMCO double-head table-type leveling and splitting machine

Double-Head Leveling, Splitting Unit

A table-type leveling and splitting machine with twin cutting heads for use on such synthetics as polyurethane and polyvinyls has been introduced by Falls Engineering & Machine Co., Cuyahoga Falls, O. The machine levels and splits stock to ⅛-inch and handles slabs of synthetic foam up to 84 inches wide and 13½ feet long.

Said to be a completely automatic unit, the machine has such features as a marine plywood table with an abrasive covering for keeping the stock in place, which is rigidly fastened to a strong structural steel frame which travels on roller-bearing grooved wheels at a speed variable from 11 to 44 feet a minute, and an automatic self-indexing mechanism for setting the depth of the cut to the required thickness.

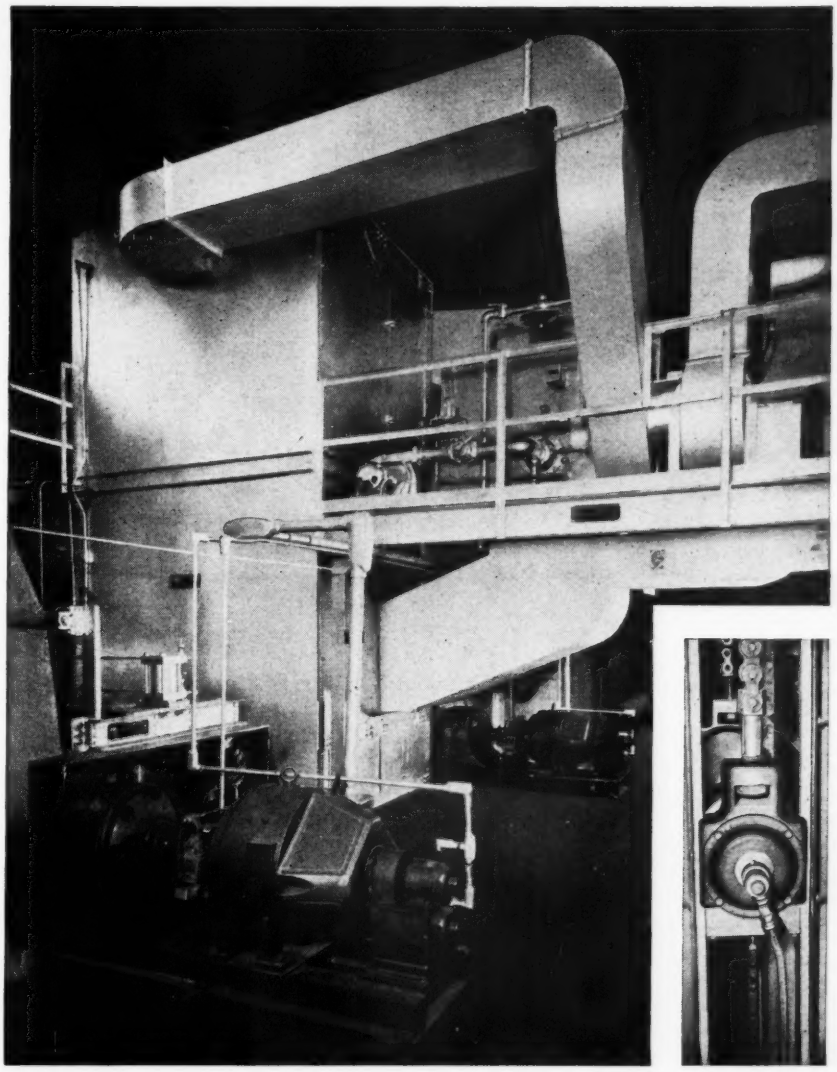
Four table sizes are available: 64 by 110 inches; 64 by 162 inches; 84 by 110 inches; and 84 by 162 inches.



Tracerlab's BG-7 beta gage

Beta Gage with Radioactive Krypton

A series of beta gages utilizing radioactive krypton as a source of radiation has been developed by Tracerlab, Inc., Boston, Mass. Designated the BG-7 model, the gage is said to be more sensitive than previously available gages using cesium or similar sources and is expected to find application in the manufacture of rubber, plastics, and other lightweight materials. The BG-7 offers a maximum desirable sensitivity of about 1.0 mg. per sq. cm. The krypton is sealed in a stainless steel container.



Within the first day of startup, full width nylon tire cord processed in this 30-yard-per-minute, 14,000-pound-tension **IOI** Rollevator® Oven*, was made into aircraft tires meeting all qualification tests.

The Rollevator® roll automatically moves up and down within the oven, in direct relation to line speeds. Thus, at *any line speed, heat-exposure* time of the nylon is held *constant* at a constant temperature setting and at constant tension.

Rollevator® Oven* hot stretches nylon tire cord at constant optimum temperature, constant time and constant tension, at variable line speeds

The IOI Rollevator® Oven* is the answer to more uniform hot stretching of nylon with greater production efficiency. Simple and automatic in operation, it practically eliminates costly shutdown and repair time. When the line is stopped the Rollevator® roll automatically lowers out of the heat zone, eliminating the need for quick cool purging of the oven and the time and expense involved in reheating the oven when starting up again. Its low operating cost combined with low initial cost assures you of lower production cost. An IOI sales engineer will be glad to give you complete information about the Rollevator® Oven* and to discuss your requirements for any system from 3 to 100 yards per minute.

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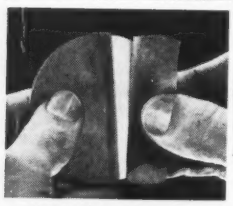
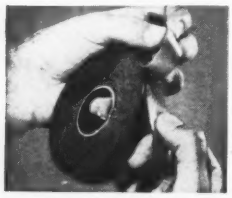


Ideal backing for pressure sensitive surfaces



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Portable Hydraulic Circuit Tester

Schroeder Model PT-50-B

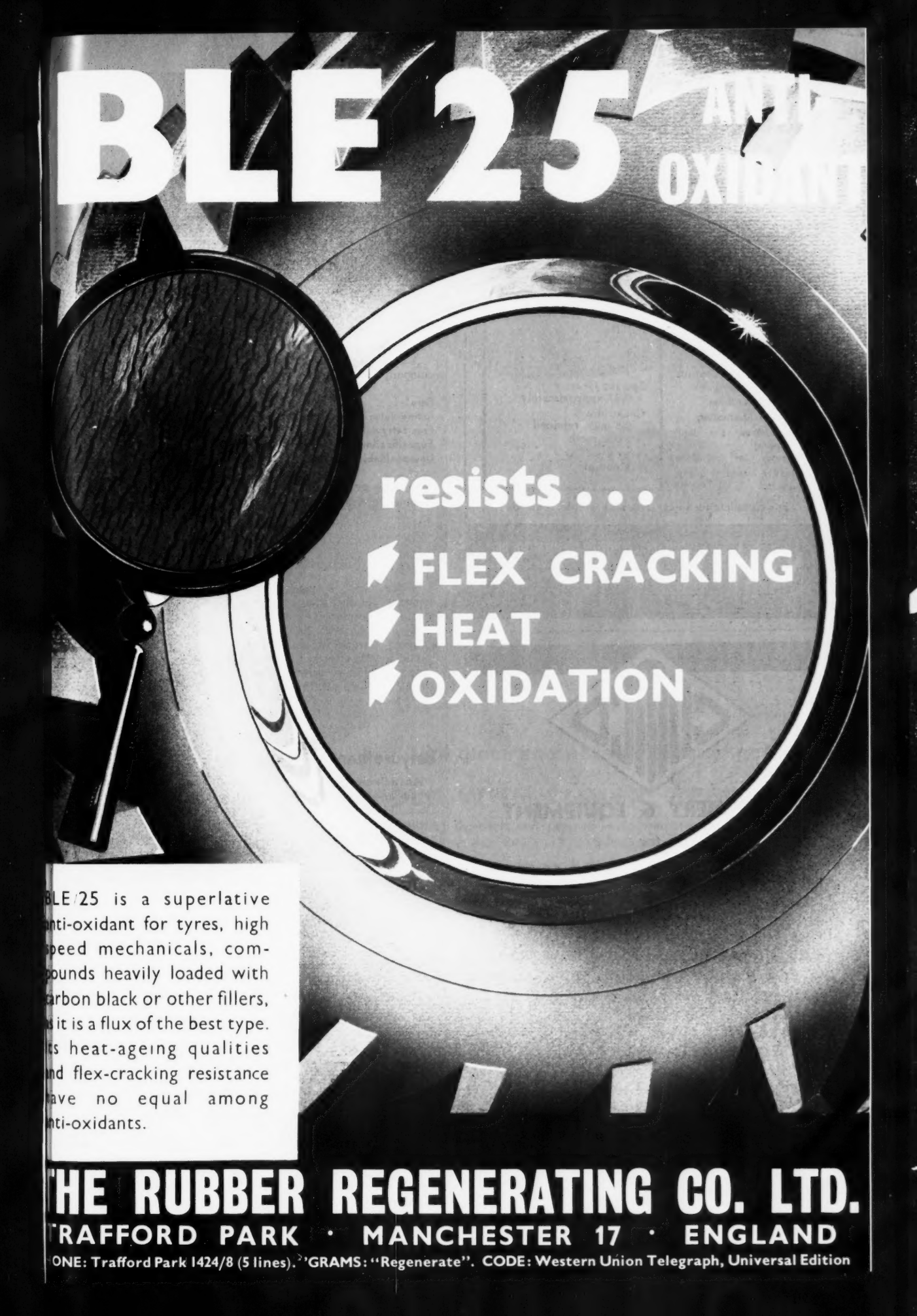
A portable hydraulic circuit tester for checking the efficiency of a hydraulic system and finding possible malfunctioning has been placed on the market by Schroeder Bros. Corp., Pittsburgh, Pa. Designated Model PT-50-B, the circuit tester simultaneously measures the temperature, pressure, and flow from any component port in a hydraulic system. The apparatus weighs 19 pounds, has a pressure range of 300-2,000 psi., a maximum flow of 50 gpm., and a temperature gage reading from 60 to 220° F. This tester is contained in a case with carrying handle.

According to the company, the tester is connected by hose to the component port to be tested and to a low-pressure return line. Load is applied manually by the load valve, with the result showing on the flow and pressure gages. Screens protect the circuits sensitive to foreign particles. These are said to be simply arranged for easy removal when cleaning is necessary.

Seacastle Model R4 Heater

Portable High-Frequency Heater

A portable high-frequency heater with a maximum compound capacity of 2¼ pounds and a heating output of one kilowatt is available from Gary Wells Co., New York, N. Y. Designated Seacastle Model R4, the heater, made by Obel-P-Products, Copenhagen, Denmark, is said to be an efficient production tool in the compression molding of plastics and can be used in the laboratory for moisture measurements, dehydration, and heating of rubber samples, chemicals, and synthetic materials. Having a time control adjustable up to five minutes, the heater features an oven door that opens automatically when the heat cycle has been completed. Operating frequency of the R4 is reported to be 40.68 Mc.



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SPECIFICATIONS and PROPERTIES

Appearance
Milky white liquid

Solids
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Specific Gravity
0.97 approximately

Coagulum
0.5 max. retained in 60 mesh

Viscosity
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NEW MATERIALS

Harwick Standard Double Pressed Red Oil

A double pressed oleic acid, suggested for use with processes or formulations which require a good grade of red oil, but which do not necessarily call for rigid standards of clarity and odor, has been added to the line of Harwick Standard Chemical Co., Akron, O. Called Double Pressed Red Oil, it is a dark, reddish-brown, oily liquid at room temperature, containing about 75.5% oleic acid, 12.5% saturated acids, 10.5% polyunsaturated acids, and 5.5% neutral oil.

A typical analysis of the product has been reported by the company as follows:

Titre	6-8° C.
Iodine value	84-88%
Free fatty acid (as oleic)	90-93%
Saponification value	198-202
Unsaponifiable matter	2.0% max.

Bulletin #05-84-0-5-56, available from the company, describes Double Pressed Red Oil in detail.

Higher Density Lead-Free ZnO—Azodox

A new type of lead-free zinc oxide said to have a higher apparent density, thus requiring less storage space, has been placed on the market by American Zinc Sales Co., Columbus, O. Designated Azodox, this zinc oxide needs only half the storage space of conventional zinc oxides, according to the company, and is said to effect further savings by incorporating and dispersing faster in Banbury mixers and open mills, as well as in other chemical equipment. Freer flow and less dusting are also claimed for Azodox.

Polyurethane, Rubber, Vinyl Foam Adhesive

An adhesive for bonding polyurethane foam to itself or to rubber and vinyl foam has been introduced by Anchor Adhesives Corp., Flushing, N. Y. Designated #292 Polyseam, it is a synthetic, elastomeric, solvent-type adhesive that dries to a transparent film and leaves a soft, flexible, almost invisible seam, according to the company. The seam is said to lose all depression tack within 12-24 hours and does not harden with age.

The absence of compression set of the seam after several hours makes it ideal for fabrication of upholstery units, the company declares. Application of the adhesive is by brush or machine. Weighing 7.2 pounds a gallon and having a viscosity of 600 cps., Polyseam is a one-part compound which does not require the addition of a catalyst or heat. Although primarily intended for the bonding of foam materials to each other, Polyseam can also bond foam to such materials as wood, masonite, steel, and aluminum.

Claremont Vinyl Inlay Printing Inks

A line of solvent-based inks for inlay printing on vinyl has been introduced by Claremont Pigment Dispersion Corp., Roslyn Heights, L. I., N. Y. Designated "VC" Series, it is said to be available in a full range of storage stable colors, including metallics. Among the advantageous properties of the inks, as reported by the company, are extremely high flash point, non-corrosiveness to rubber rolls, stability in the fountain, good adhesion, and formation of sharp and opaque prints. The inks are packaged in five-gallon pails.

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Cellosize Latex Paint Thickener

A high-viscosity thickening agent for latex paints has been introduced by Carbide & Carbon Chemicals Co., New York, N. Y. Designated Cellosize WP-4400, it is a hydroxyethyl cellulose that is claimed to impart to latex paints such properties as excellent scrub resistance, good brushability, flow out, and leveling, and enhanced mechanical, freeze-thaw, and viscosity stability. A water-soluble, free-flowing, white powder, Cellosize WP-4400 is a nonionic product, making it generally more stable in the presence of salts and acids than anionic thickeners and dispersants, according to the company.

The new thickening agent is also said to maintain excellent pigment dispersion in latex paints, resulting in rich colors with a minimum amount of pigment and a paint film with less color variation. It does not gel at temperatures up to the boiling point of water.

Some physical properties of Cellosize WP-4400 have been reported as follows:

Viscosity, 2% aqueous sol. @ 20° C., cps.	3,500-5,000
Salt content, % by wt., max.	4
Solubility in water, % by wt., min.	99.0
Moisture content, % by wt., max.	5.0
pH, 2% solution	6-8

G-E Silicone Rubber Cloth Coating

A silicone rubber cloth coating compound with an operating temperature range of —120 to 600° F. has been added to the line of the silicone products department of General Electric Co., Waterford, N. Y. Designated SE-701U, it was especially designed for the manufacture of heater ducts, providing improved flame retardancy, outstanding heat resistance, and excellent handling properties, according to the company. Offering good adherence to glass cloth, good building tack, and easy cures, SE-701U, a low compression set compound, can also be used for such applications as jet engine starter hose, flexible connectors for metal hose, and for fire wall seals, G-E reports. This compound shows low swell in such fluids as Skydrol 500 and 700, JP4, gasoline, MIL-o-7808, and MIL-5606. Only the uncatalyzed silicone compound is available.

A data sheet on SE-701U, reporting typical properties of the cured compound and giving suggestions for storage and fabrication, is available from the company on request.

UCC L-522 Tire Release Agent

An experimental low-viscosity organo-silicone material has been found valuable as a release agent in the tire industry and is now being offered commercially by the silicones division of Union Carbide & Carbon Corp., New York, N. Y., manufacturer of the product. Designated L-522 organo-silicone compound (originally X-522), it can be used for lubrication of both inside and outside of green tires to be cured in both Bag-O-Matic and conventional machines. Both inside and outside formulations can be sprayed simultaneously as the green tires pass through a paint-spray hood, the company says. White gasoline, mica dust, and pigment usually make up the body of these formulations.

A light-yellow liquid soluble in aromatic and aliphatic organic liquids and insoluble in water, L-522 is also effectively compatible with subsequent treatments to the tire, such as label cements and balancing dough, according to Union Carbide & Carbon Corp.

Some physical properties of L-522, as reported by the company, are as follows:

Viscosity, cstks., @ 77° F	95
100° F	75
210° F	16
Pour point, °F	—56
Flash point, C.O.C., °F	410
Fire point, C.O.C., °F	445
Coefficient of expansion, x 104	7.5
Surface tension, dyn/cm.^{2}	21.6

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Over the years, Witco-Continental has grown steadily with the rubber industry. This planned expansion of our plant facilities...research and technical laboratories ...places us in an excellent position to meet every rubber black need and to assist our customers with their carbon black problems.

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Continex HMF—High Modulus
Continex HAF—High Abrasion
Continex FEF—Fast Extruding
Continex ISAF—Intermediate Super Abrasion
Continex CF—Conductive Furnace

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Continental A—(MPC)—Witco No. 1
Continental F—(HPC)—Witco No. 6
Continental R-40—(CC)—Conducting

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When POLYPOL S-70 replaces these resins in soling – or in other semi-hard items subject to distorting heat – the problem is reduced to a minimum. Costs go down too.

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U. S. Rubber Dump-Truck Tire

U. S. Royal Super Fleetmaster

A new off-the-road tire for dump trucks and other heavy-service equipment used in logging, mining, quarrying, and road construction work is being offered by United States Rubber Co., New York, N. Y. Called U. S. Royal Super Fleetmaster, the tire is of nylon cord construction and has such features as an irregular groove pattern, said to eliminate much groove cracking and to aid in the ejection of stones; a center control rib in the three-rib design, reported to result in better control and stability; and non-directional lugs, claimed to permit the tire to be used on any wheel. Sizes are from 12.00-24 with a 16-ply rating through 16.00-25 with a 24-ply rating.

Flexible Fluorocarbon Aircraft Hose

A jet and rocket aircraft hose that retains its flexibility and strength at temperatures ranging from —100 to 450° F. is being made by B. F. Goodrich Industrial Products Co., Akron, O. The hose is intended for use as fuel, lubricant, and hydraulic lines in jet and conventionally powered aircraft, as well as in rockets and guided missiles. Made of tetrafluoroethylene (Teflon), the hose is of seamless construction and is reinforced with braids of stainless steel wire and weighs about half as much as conventional aircraft hose.

Goodrich will manufacture it under a license agreement with Resistoflex Corp., Belleville, N. J., which will continue to make and market its own flexible fluorocarbon hose.

Inflatable Vinylfoam Pillow

An inflatable general utility pillow made of Vinylfoam is being offered by Vinyl Linens, Inc., New York, N. Y. Designated #802 Foamastic Pillow, it is said to be lightweight and collapsible and to provide a soft, cool exterior surface. Vinyl film electronically heat-sealed between layers of vinyl foam retains the air in the pillow. Suction cups provide for surface adherence.

Goodyear Terra-Tone Vinyl Flooring

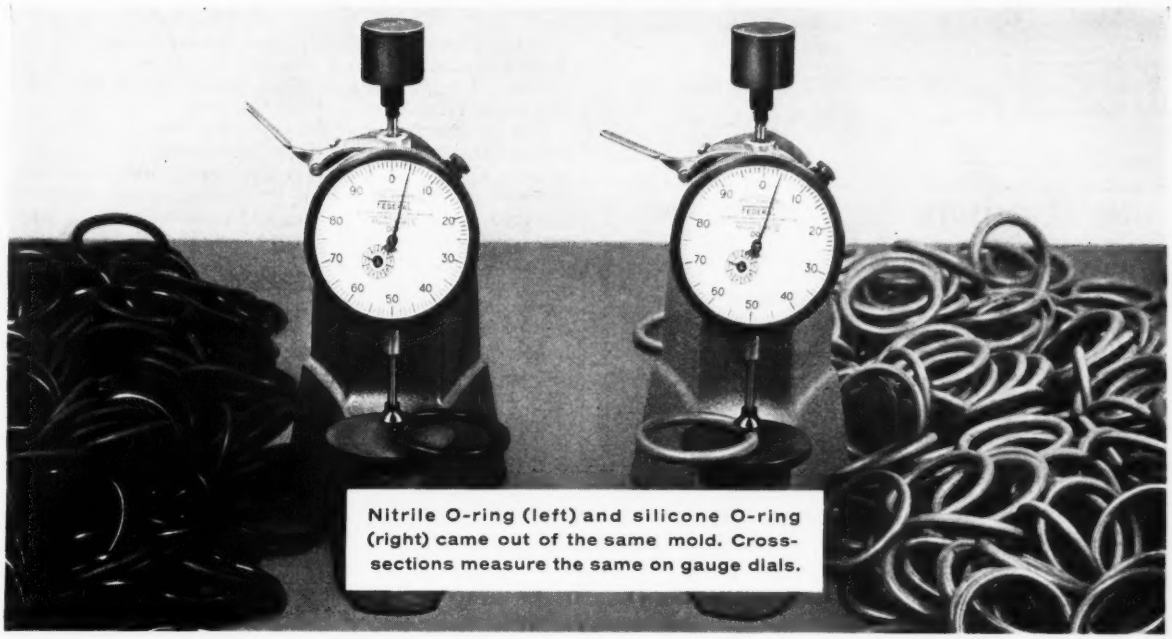
A new line of vinyl flooring incorporating color flecks within a basic color background has been introduced by the flooring department of The Goodyear Tire & Rubber Co., Akron, O. Dubbed Terra-Tone, the series is being manufactured in 0.080-gage in both nine- by nine-inch tile and 45-inch-wide roll goods for light commercial and residential use.

According to Goodyear, the colors available are pepper grey, wheat beige, melon green, cranberry red, vanilla beige, mushroom grey, avocado green, apple green, and cinnamon brown.

Now–SILICONE RUBBER with the

SAME SHRINKAGE

as organic rubber!



Nitrile O-ring (left) and silicone O-ring (right) came out of the same mold. Cross-sections measure the same on gauge dials.

G-E Improved Class 300 Silicone Rubber

- **Eliminates the need for special molds**
- **Maintains closer tolerances**
- **Lowers reject rate**

Now–for the first time–silicone rubber is available with the *same shrinkage as organic rubber!* General Electric's improved Class 300 makes it unnecessary to tool costly, special molds for silicone rubber jobs. It means closer tolerances on O-rings and other precision parts, meeting AN requirements without difficulty. And reject losses are practically nil, because more parts are held within tolerances.

Ideal for O-rings

With G.E.'s improved Class 300, silicone rubber parts can be produced from existing molds with tolerances as good, if not better, than obtained with organic rubber. Ideal for O-rings, Class 300 offers excellent low compression-set characteristics between –90 and 400 F . . . low swell in oils . . . practically zero moisture absorption . . . and better steam resistance than ever before. It contains no toxic additives and it oven-cures in shorter times to develop optimum properties.

Immediately available

Finished compounds are ready for fabrication right now. Silicone rubber gum formulations are available for fabricators who prefer to compound their own stocks.

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GENERAL ELECTRIC

SILICONE PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
Section 61-7H, Waterford, N. Y.

Please send more information on G.E.'s Improved Class 300 Silicone Rubber. I am interested in:

☐ Finished compounds ☐ O-rings
☐ Compounding from gum ☐ _____ (Specify application)

Name_____ Position_____

Firm_____

Street_____

City_____ Zone_____ State_____

IN CANADA: Mail to Canadian General Electric Company, Ltd., Toronto

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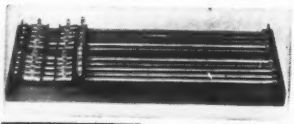
For Cold Tension Recovery Test
fulfilling Specification MIL-C 12064(CE).



This equipment is also a must to adequately control the production of compounds intended for wire coverings, rubber belting and tire carcasses.

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TECHNICAL BOOKS

BOOK REVIEWS

"Annual Report on the Progress of Rubber Technology." Vol. XIX, 1955. Edited by T. J. Drakeley. Institution of the Rubber Industry, London, England. Cloth cover, 7¼ by 9¾ inches, 162 pages. Price, $2.94.

This IRI compilation of the progress of natural and synthetic rubber technology throughout the world during 1955 is, as usual, of great value to all sections of the industry. Beginning with a historical and statistical review, the contents include chapters on the following subjects: planting and production of raw rubber and latex; properties, applications and utilization of latex; chemistry of raw and vulcanized natural rubber; synthetic rubber; testing and equipment and specifications other than for latex; compounding ingredients; fibers and fabrics; tires; belting; hose and tubing; cable and electrical insulation; footwear; mechanical rubber goods; games, sports accessories, and toys; surgical goods; textile-rubber composites, solvents and cements; cellular rubber; hard rubber; flooring; works processes and materials; machinery and appliances; and roads.

References to the literature are extensive, probably making up one-quarter of the textual space. A name index and a subject index are included.

This year's chapter on synthetic rubber by W. J. S. Naunton is especially comprehensive, in view of the great strides the product has made during 1955 under the leadership of American producers. Mr. Naunton terms the development of synthesized tree rubber "the most interesting event of the year" in the rubber industry. He also discusses such subjects as the transfer of the American synthetic rubber industry to private enterprise, the competition between natural and synthetic rubber, the advances in oil-resisting rubber, Poly FBA, Kel-F, progress in butyl rubber, the new polyurethane rubbers, and the continued research in silicone rubbers, in polyethylene, and in polyvinyl chloride.

"Chemical Market Research in Practice." Edited by Richard E. Chaddock. Reinhold Publishing Corp., New York, N. Y. Cloth cover, 5 by 7½ inches, 196 pages. Price, $3.

This text on chemical market research was edited from a series of lectures on the subject originally given in 1953 and 1954 at Case Institute of Technology and the University Extension Division of the University of Delaware. The authors, 22 of them, are associated with major American chemical companies and are members of the Chemical Market Research Association. Their compiled contributions to this book represent both an overall view of the subject and a close look at specific industries.

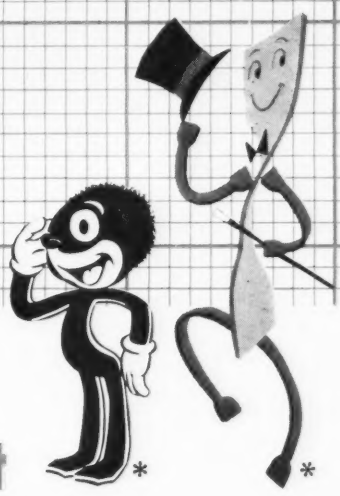
Topics discussed include the organization and growth of the chemical industry, the chemical market survey, the effective utilization of literature, field work, the presentation of market research results, the integration of research and development with market research, market research in policy planning and finance, and an appraisal of the human factor in chemical market research. Covered specifically are the plastics, synthetic fiber, synthetic detergent, petrochemical, sulfur, and paint, varnish, and lacquer industries. Case studies, including one on The Goodyear Tire & Rubber Co., heighten the practicality of the text.

NEW PUBLICATIONS

"Profession Standards and Employment Conditions." Engineers Joint Council, New York, N. Y. 14 pages This EJC report puts forward recommendations for raising the professional standards and improving employment conditions of engineers.

Philchem

RUBBER CHEMICALS
NEWS ITEM NO. 4



Philblack* A For Carcass Reinforcement

Present day tires are subjected to a large amount of flexing, and experience has shown that tires built with a high modulus carcass exhibit excellent performance. Philblack A imparts high modulus which results in a stronger carcass with less cord movement and low heat generation. High modulus, relatively low heat generation, good flexing properties and high tensile strength at elevated temperatures make Philblack A especially desirable for use in the carcass of the large cross-section 14-inch diameter tire.

Carcass stocks must have excellent overcure characteristics so the properties will not deteriorate in prolonged high temperature service. Excellent retention of modulus and tensile strength in the overcure range is shown in Table I for a Philblack A reinforced Philprene* rubber carcass compound (Recipe A). Table II illustrates the balance of physical properties imparted by Philblack A in a carcass compound made up of a blend of smoked sheets, reclaims and Philprene rubbers (Recipe B).

Complete Technical Service

For individual advice on processing and recipes, call your Phillips technical representative. He will give you the benefit of Phillips extensive research facilities plus years of practical experience in solving rubber problems.

SUMMARY OF PHYSICAL PROPERTIES

TABLE I

	MINUTES CURE AT 280°F					
	45	**60**	**90**	**120**	**210**	**300**
300% Modulus, psi	1090	1260	1440	1575	1530	1530
Ultimate Tensile, psi	2925	2840	2500	2550	2540	2550
Ultimate Elongation, %	650	570	460	450	445	445
Shore A Hardness	54	55	56	57	57	58

TABLE II

	MINUTES CURE AT 307°F		
	15	**25**	**40**
300% Modulus, psi	1200	1240	1240
Ultimate Tensile, psi	2310	2260	2200
Ultimate Elongation, %	500	465	460
Shore A Hardness	56	56	56
Ultimate Tensile (Aged 48 hrs./212°F), psi	1750	1740	1730
Ultimate Elongation (Aged 48 hrs./212°F), %	290	315	315
Crescent Tear Across Grain, Lbs./in. @ 80°F	222	265	283
Crescent Tear, Lbs./in. @ 212°F	158	172	179
Heat Build-up, △ T°F	—	43	47

Compounding Recipes

	A	**B**
Philprene 1500	100	—
Philprene 1006	—	40
Smoked Sheets	—	40
W. T. Reclaim	—	40
Philblack A	35	33
Zinc Oxide	5	3
Stearic Acid	2	1
Oil	6	5
Antioxidant	—	1.5
Sulfur	2.5	2.5
Accelerator	1.25	0.95

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Rubber Chemicals Division
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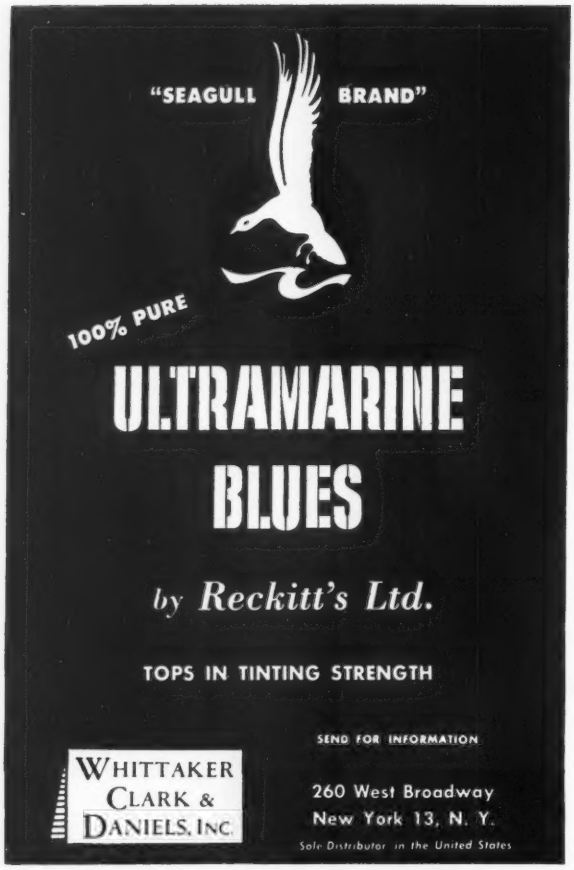
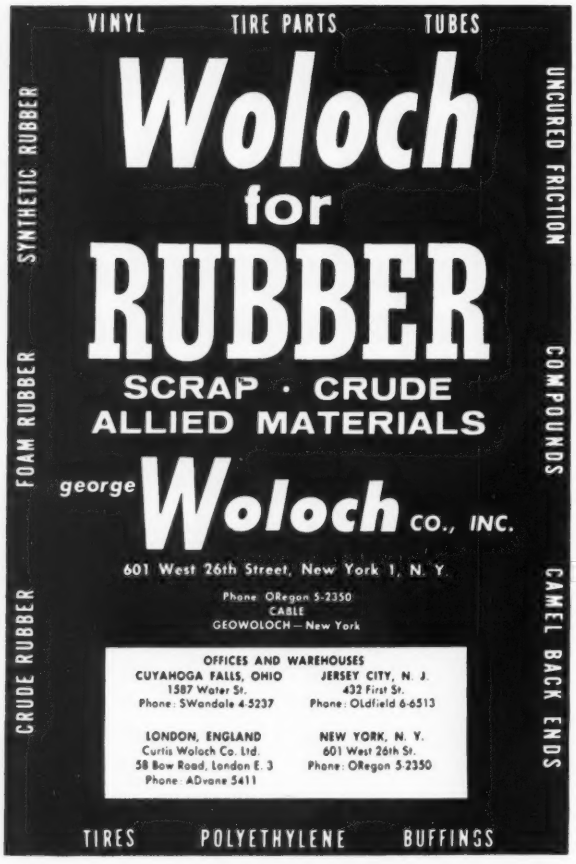
*A trademark





"Lantuck." Wellington Sears Co., New York, N. Y. 16 pages. The characteristics and uses of Lantuck, a non-woven industrial fabric made of any natural or synthetic fiber or combination of fibers bonded with a resin, are described in this booklet. Included in the suggested uses are backing for plastic coating and shoe parts.

"Enjay Butyl Bulletin." No. 3. Enjay Co., Inc., New York, N. Y. 2 pages. The results of outdoor exposure tests on Enjay Butyl rubber compounded with some 20 coloring agents are reported in this publication. The trade names, chemical type, and suppliers of the colors are included in the tabulation.

"Vygen 2201." The General Tire & Rubber Co., chemical division, Akron, O., 14 pages. The physical and chemical properties, processing, and other technical data on the company's new modified rigid PVC compound for calendering rigid thermoplastic postformable sheets are discussed in this booklet.

"Poly-Koolfoam." The Dayton Rubber Co., Dayton, O. 16 pages. The chemistry, properties, applications, and fabrication of the company's polyurethane foams are discussed in this illustrated booklet.

"Hycar Latex Newsletter." Issue No. 12. B. F. Goodrich Chemical Co., Cleveland, O., 4 pages. Stabilizers for Hycar 4501 latex, the effect of thickeners on the viscosity of Hycar 4501, and greaseproof coatings obtained by blending Hycar latices are the subjects discussed in this issue of the Newsletter.

"Kel-F Fluorocarbon Products." M. W. Kellogg Co., chemical manufacturing division, Jersey City, N. J. 8 pages. The forms, properties, and uses of a wide range of fluorocarbon products, including elastomers, are described in this illustrated brochure.

"Plaskon Polyethylene Lubricant 8407 in a Butadiene-Styrene Copolymer (Cold) Tread-Type Compound." Rubber Laboratory Release No. 17. Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. 12 pages. The properties of Plaskon 8407 and four basic formulae employing it in cold butadiene-styrene copolymer tread-type compounds, together with extensive physical test data on these compounds, are given in this booklet.

"Galex." Thiokol Chemical Corp., Trenton, N. J. 6 pages. The properties, uses in rubber compounding, and tabulated effect of 10-40 parts of Galex on SBR tread-type stocks are included in this publication. Galex is a free-flowing stabilized rosin tackifier in pelletized form manufactured by G & A Laboratories and marketed by Thiokol to the rubber industry. Galex was heretofore only available in solid form.

"Monomer Headquarters for the Resin Industry." F-40033. Carbide & Carbon Chemicals Co., New York, N. Y. 4 pages. The physical properties and uses of 36 of the company's monomers are contained in this illustrated folder.

"Quality Control and Applied Statistics Abstracts." Interscience Publishers, Inc., New York, N. Y. About 1,000 pages annually. Price, $60 a year. This is a new monthly loose-leaf abstract service covering the world literature on quality control, operations research, and industrial applications of statistical methods of all kinds.

"Rigid Koroseal Pipe, Fittings and Valves." The B. F. Goodrich Co., plastic products, Marietta, O. 8 pages. The properties, applications, and installation of the company's high-impact rigid Koroseal pipe, fittings, and valves are described in this illustrated brochure.

"Asco" Solenoid Valves." Condensed Valve Catalog No. 201. Automatic Switch Co., Orange, N. J. 32 pages. Specifications and operational data on the company's line of two-, three-, and four-way solenoid valves are contained in this illustrated catalog.

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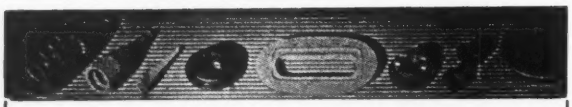

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Publications of Witco Chemical Co., New York, N. Y.:

"Witco #20 Softener." Technical Service Bulletin R-11. 1 page. The physical properties and applications of the firm's plasticizer #20 for natural rubber and SBR are given on this data sheet.

"Witco #20 *vs.* Pine Tar in Smoked Sheet Tread Stock." Technical Service Bulletin R-12. 2 pages. The firm's #20 softener is compared to pine tar in smoked sheet tread stock. Recipes and postcure test data are given.

Publications of Harwick Standard Chemical Co., Akron, O.:

"Plasticizer SC." Bulletin #06-72-3-5-56. 12 pages. The physical and chemical properties of the company's triglycol ester of a vegetable-oil fatty acid are reported on these data sheets. The plasticizer is said to impart low-temperature properties to nitrile rubber or to polyvinyl chloride compositions and is also valuable in neoprene compounding. Sample recipes and test data are included.

"Lubri-Flo." Bulletin #11-124-2-5-56. 1 page. The company's mold lubricant for use on white, light-colored, brown, or black rubber stocks is described here.

"Thixon Summary." #03-1-5-5-56. 2 pages. This bulletin is a summary of the company's currently available Thixon products for the adhesion of rubber and rubber-like materials to metals.

Publications of E. I. du Pont de Nemours & Co., Inc., elastomers division, Wilmington, Del.:

"High Tear Strength Neoprene." W. J. Schrantz. Report BL-315. 4 pages. The use of a small amount of natural rubber and a moderate loading of precipitated hydrated silica with Neoprene Type GN or Type GRT in obtaining neoprene stock with unusually good tear strength at room and elevated temperatures is discussed here.

"Neoprene Type WX." D. C. Thompson and J. F. Hagman. Report No. 56-1. 8 pages. The physical properties of Neoprene Type WX, a new polymer having crystallization resistance intermediate between that of Type W and Type WRT are reported in this publication, together with detailed information on crystallization effects relative to other types of neoprene.

"Neoprene Notebook." Issue 69. 8 pages. This issue of the Notebook includes illustrated articles on the measurement of the oil resistance of neoprene, a neoprene automobile seat adjuster coupling, a pharmaceutical conveyor belt made of the rubber, neoprene frames for sliding windows, and other neoprene products.

"Mathieson Industrial Chemicals." Olin Mathieson Chemical Corp., industrial chemicals division, Baltimore, Md. 20 pages. The complete line of Mathieson chemicals for the industry is described briefly in this booklet. Uses are given for the organic chemicals and specialties in the line.

"Servotherm Thermistor Heat Detector Cells." Technical Bulletin 1300-1. Servo Corp. of America, New Hyde Park, N. Y. 4 pages. The company's heat detection units for use where direct contact with the source is impractical are described in this illustrated brochure.

"ASTM Standards on Metallic Electrical Conductors." December, 1955. American Society for Testing Materials, Philadelphia, Pa. 300 pages. Price, $3.50. All of the ASTM Standards pertaining to metallic electrical conductors are compiled in this book. Standards cover copper, copper alloy, and copper-covered steel wire, stranded conductors, rods, bars, pipes, and tubes; aluminum wire, stranded conductors, rods, and bars; and galvanized steel core wire, and galvanized iron and steel guy, messenger, span, overhead ground, and line wire.

"U.S.I. Polyethylene Processing Tips." U. S. Industrial Chemicals Co., New York, N. Y. 4 pages. These suggestions are the first in a series for the processing of the company's and other polyethylene resins. A folder for these data sheets is included.

"B. F. Goodrich Air Hose." Bulletin 3460. The B. F. Goodrich Industrial Products Co., Akron, O. 2 pages. The company's air hose is discussed in this illustrated specification sheet.

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MARKET REVIEWS

Natural Rubber

Natural rubber prices continued to rise during the June 16-July 15 period; the #1 grade recorded a high of 34.88¢ on the spot market on July 11, after having seen a low of 30.75¢ a pound on June 19, resulting in a high-low differential of 4.13¢, an about-normal swing for the rubber market. Trading on the New York Commodity Exchange amounted to 37,470 tons of R.S.S. #1, reflecting the relative indifference of the market. Trading on the new Standard Contract was still inconsequential.

Contributing to the rise of prices were such factors as the Middle East political situation, Russian buying in the Far East, and President Eisenhower's reaffirmation of his decision to run for a second term. These forces proved too strong for such negative factors as the steel strike, labor negotiations in the rubber industry, and continuing cutbacks in automotive output.

Statistically, sales on the New York Commodity Exchange for the second half of June were 19,200 tons of R.S.S. #1, bringing the monthly total to 41,490 tons, slightly better than May's 38,890 tons, which was the lowest figure in the previous 12 months. Sales during the first half of July were 18,350 tons. It should be borne in mind, however, that trading in the #1 R.S.S. grade will be suspended this December as far as the old regular and 1956 standard contract are concerned, which is diminishing total trading in far-futures. The burden of futures trading will, therefore, be slowly assumed by the new Rex Standard Contract. There were 19 trading days during the June 16-July 15 period.

COMMODITY EXCHANGE
WEEK-END CLOSING PRICES

Futures	May 25	June 22	June 29	July 6	July 13
May	27.30	....	....	....	....
July	27.25	30.65	33.00	34.40	33.25
Sept.	26.55	29.20	30.95	32.30	32.15
Dec.	25.90	27.85	29.25	30.00	30.30
Total weekly sales, tons	8,590	7,230	11,890	5,750	12,600

On the physical market, R.S.S. #1 began the period at 31.75¢ a pound, fell to the period low of 30.75¢ on June 19, climbed with fluctuations to the period high of 34.88¢ by June 11, and fell back to 33.50¢ on July 13, the end of the period under consideration.

Average June monthly spot prices for representative grades were as follows: R.S.S. #1, 30.83¢; R.S.S. #3, 30.37¢; #3 Amber Blankets, 24.05¢; and Flat Bark, 19.04¢. For the first half of July, the #1 grade averaged 34.02¢.

NEW YORK SPOT MARKET
WEEK-END CLOSING PRICES

	May 25	June 22	June 29	July 6	July 13
R.S.S.: #1	28.63	31.25	33.25	34.25	33.50
2	28.50	31.00	33.00	33.88	33.13
3	28.38	30.75	32.75	33.50	22.75
Latex Crepe #1 Thick	34.75	37.88	38.50	39.38	38.63
Thin	34.75	37.88	38.50	39.38	38.63
#3 Amber Blankets	24.63	24.75	25.50	27.63	27.25
Thin Brown Crepe	24.25	24.50	25.25	26.25	26.75
Flat Bark	19.38	19.50	19.75	20.38	19.88

No. 1 RSS Rex Contract Added to Exchange Trading

Beginning with its September issue, RUBBER WORLD will carry monthly reports of trading on the New York Commodity Exchange in two new rubber futures contracts, Standard #1 RSS Contract and Rex #1 RSS Contract. Trading in the old RSS #1 Contract will expire with the December 1956 position.

Trading on the Standard Contract was inaugurated on the Exchange on January 23, 1956. Trading on the newer Rex Contract was approved by the membership of the Exchange on July 23 after it had been proposed by the Exchange's board of governors.

A unit eligible for certification under the Standard Contract is defined as falling in quality between RSS #1 and RSS #2. A lot determined to be inferior to the #1 grade is subject to a discount allowance of 1¢ a pound. There is no graduated discount allowance for degree of inferiority. A unit containing slightly stained bales up to 10% is subject to a discount allowance of ⅛¢ a pound on the entire contract unit.

A unit eligible for certification under the Rex Contract is defined as being not more than ½-grade off RMA #1 RSS. Bale sizes and weights must conform to the RMA Packing Specifications: namely, a maximum of 250 pounds and a minimum of 224 pounds packed to a five-cubic-foot parcel. The allowance for delivery of rubber under RMA #1 RSS will be predetermined for each delivery position by a special committee established by the Commodity Exchange.

Until December, 1956, all three contracts will be in operation. During 1957 both the Standard Contract and the Rex Contract will be in effect. Representatives of the industry believe that trading in the Standard Contract will gradually disappear.

The Rubber Manufacturers Association, Inc., among others, has objected to some terms in the Standard Contract.

Latex

Observers report very little business in natural and synthetic latices during the June 16-July 15 period. Buying of natural latices was particularly lethargic, because of both higher selling prices and lower automotive production. Current stocks of natural and synthetic latices were thought to be adequate, although little accurate information was forthcoming from the trade.

Prices for ASTM Centrifuged Concentrated natural latices, in tank-car quantities, f.o.b. rail tank cars, ranged during the period from 37 to 42¢ per pound solids. Prices of synthetic latices remained the same, being quoted as SBR, 26-32.3¢; neoprene, 37-47¢ and N-type, 46-54¢.

Final April and preliminary May domestic statistics for all latices were reported by the United States Department of Commerce as follows:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Apr.	0	6,995	5,693	21,384
May	0	....	4,961	20,895
SBR				
Apr.	6,066	31	4,923	7,415
May	4,929	....	4,577	7,311
Neoprene				
Apr.	969	0	741	1,163
May	939	0	753	1,095
Nitrile				
Apr.	866	0	692	2,272
May	614	0	499	1,584

Synthetic Rubber

Lower automotive production, inventory cutbacks, and the traditional summer lull combined during June to shrink the market for SBR to about 20% below that for May, according to reliable reports. The reduced demand is expected to continue through July and August since the factors that influenced the June demand will continue until September, barring unforeseen circumstances. Observers believe the last quarter of the year will see a substantial boost in market demand.

Rubber producers do not anticipate further price changes, at least until September. Beyond that time they are not willing to speculate. Price increases are possible if inflationary pressures build up.

The recent annual report of the United States Tariff Commission made clear the growing health of the American synthetic rubber industry. Production of synthetic rubber during 1955 reached the record total of 2,261 million pounds, 58% above the output of 1954. The previous high was in 1951, when the output amounted to 2,003 million pounds. Sales of synthetic rubber during 1955 were about 2,240 million pounds, valued at $661 million, well above the 1954 figures of 1,497 million pounds, worth $436 million.

Production of cyclic elastomers, consisting almost entirely of styrene-butadiene rubber, was triple that of acyclic elastomers during 1955, 1,693 million pounds and 568 million pounds being produced in the respective categories. Sales were $418 million and $243 million, respectively.

Styrene-butadiene rubber sold for an

average of 25¢ a pound; whereas the average selling price was 23¢ when the industry was being operated by the government.

Scrap Rubber

Quiet conditions characterized the scrap rubber market during the period from June 16 to July 15 as the industry settled into the traditional summer doldrums. The easier demand by most reclaimers pushed some prices down fractionally. The situation is expected to continue throughout July and into August.

Scrap rubber imports during March declined by more than 256,000 pounds from arrivals the preceding month, according to the Bureau of the Census, United States Department of Commerce. Imports in March were 2,590,882 pounds, valued at $126,287, compared to the 2,847,574 pounds, worth $149,137, which came into the country during February. Export figures for March were not yet available.

Period-end buying prices for scrap rubber grades follow:

	Eastern Points	Akron, O.
	(Per Net Ton)	
Mixed auto tires	$14.00/15.00	$15.00
S.A.G. auto tires	Nom.	Nom.
Truck tires	14.00	17.00
Peelings, No. 1	40.00	40.00
2	Nom.	24.00
3	16.00	19.00
Tire buffing	Nom.	Nom.
	(¢ per Lb.)	
Auto tubes, mixed	2.25	2.25
Black	5.50	5.50
Butyl	Nom.	Nom.
Red	6.50	6.50

Reclaimed Rubber

The reclaimed rubber market continued lethargic during the June 16-July 15 period. Traditional summer inactivity, together with the anticipated drop in automotive production, accounted for the lull. One reclaiming company, however, reported that its business was higher than expected during this period. Improved conditions generally are not looked for before the middle of August.

Exports of reclaimed rubber during March increased by 109,262 pounds over the February figure, according to the Bureau of the Census, United States Department of Commerce. The total was 2,605,766 pounds, valued at $245,700, compared with the 2,496,504 pounds, worth $231,677, exported during February.

The price of reclaimed butyl inner tubes was reduced 1¢ a pound during the period. The current price schedule is as follows:

RECLAIMED RUBBER PRICES

	Lb.
Whole tire: first line	$0.105
Fourth line	.0925
Inner tube: black	.15
Red	.21
Butyl	.14
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

Rayon

Total calculated production of rayon and acetate yarn during June was 55,000,000 pounds, of which 27,400,000 pounds were regular-tenacity yarn, and 27,600,000 pounds were rayon high-tenacity yarn. May production had been: total, 63,900,000 pounds; regular-tenacity, 31,300,000 pounds; and high-tenacity, 32,600,000 pounds.

June domestic shipments totaled 50,900,000 pounds, consisting of 25,000,000 pounds of regular-tenacity yarn and 25,900,000 pounds of high-tenacity rayon yarn. May shipments had been: total, 56,900,000 pounds; regular-tenacity, 27,900,000 pounds; and high-tenacity, 29,000,000 pounds.

Total end-of-June stocks were 64,100,000 pounds, of which 50,000,000 pounds were regular-tenacity yarn, and 14,100,000 pounds were high-tenacity rayon yarn. End-of-May stocks had been: total, 61,000,000 pounds; regular-tenacity, 48,100,000 and high-tenacity, 12,900,000 pounds.

Current prices of tire yarns and fabrics follow:

RAYON PRICES

Tire Yarns

High-Tenacity	
1100/ 480	$0.62/$0.67
1100/ 490	.62/ .67
1150/ 490	.67
1165/ 480	.68
1230/ 490	.67
1650/ 720	.58/ .64
1650/ 980	.58/ .64
1875/ 980	.64
2200/ 960	.58/ .63
2200/ 980	.58/ .63
2200/1466	.67
4400/2934	.63
Super-High-Tenacity	
1650/ 720	.63/ .69
1900/ 720	.69

Tire Fabrics

1100/490/2	.77
1650/980/2	.725
2200/980/2	.715

Cotton Fabrics

Continued slow trading characterized the industrial fabrics market during the period from June 16 to July 15, but prices of wide industrial fabrics and cotton ducks remained steady. The lull in the market did not dampen the optimism of most observers, however, who generally expect buying by rubberizers, plastic coaters, and auto and furniture manufacturers to revive later in the year. These observers do not look for buying of wide fabrics by these industry groups to run so heavy as during last year, but they do anticipate some sizable covering later in the third quarter.

Another factor which has helped to give the industrial fabrics market a good undertone has been the steady reduction in inventories in the hands of rubberizers, plastic coaters, and other users of these fabrics. Inventories now are considerably lower than they were earlier in the year.

With many plants closed during July, and production generally low owing to cutbacks, most coaters have sufficient gray industrial goods on hand to hold them for some time. If the pace of trade activity and production picks up later in the quarter, however, goods on hand would be used up rapidly.

Fractional price decreases were recorded at period-end for some cotton fabrics, but in the main the market held steady.

COTTON FABRICS

Drills

59-inch 1.85 yd. *yd.*	$0.38
2.25-yd.	.325

Ducks

38-inch 1.78-yd. S.F. *yd.*	nom.
2.00-yd. D.F.	.34
51.5-inch, 1.35-yd. S.F.	.4963
Hose and belting	.69

Osnaburgs

40-inch 2.11-yd. *yd.*	.26
3.65-yd.	.165

Raincoat Fabrics

Printcloth, 38½-in., 64x60, 5.35-yd. *yd.*	.145
6.25 yd.	.12
Sheeting, 48-inch, 4.17-yd.	.20
52-inch, 3.85-yd.	.24

Chafer Fabrics

14.40-oz./sq. yd. Pl. *yd.*	.70
11.65-oz./sq. yd. S.	.61
10.80-oz./sq. yd. S.	.6575
8.9-oz./sq. yd. S.	.67

Other Fabrics

Headlining, 59-ni., 1.65-yd., 2-ply *yd.*	.465
64-inch, 1.25-yd., 2-ply	.59
Sateens, 53-inch, 1.32-yd.	.5575
58-inch, 1.21-yd.	.61

Tire Cord

1242 Standard *lb.*	.83

Goodrich Nyfil Belt Fabric

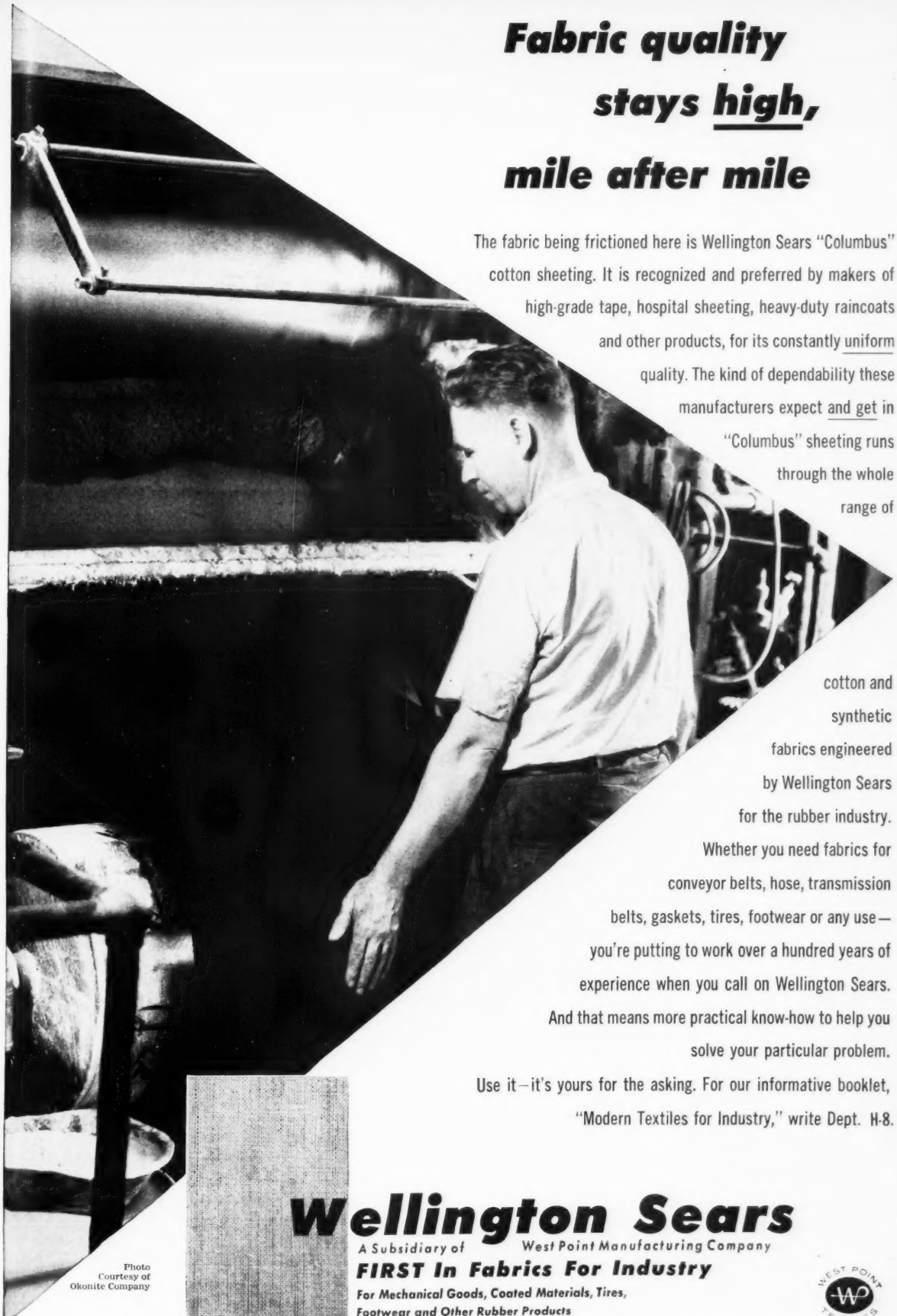
A new nylon-filled fabric that is said to be as strong as steel cable is being manufactured by B. F. Goodrich Industrial Products Co., Akron, O., for conveyor and elevator belts.

A belt made with five plies of the fabric, called Nyfil 120-RS, is claimed to be as strong as a steel cord belt rated at 1,000 pounds per inch per ply. Twenty plies of 42-ounce cotton fabric would be needed to provide the same strength, it is said.

Nyfil 120-RS is reported to be a combination of super-strength rayon with nylon filler. It is said to permit belt operating tensions up to 200 pounds per inch per ply width, which in the past have been met only by using steel cables for interior reinforcement of belts.

According to Goodrich, the new fabric allows longer single flights of the belt, makes for exceptional flexibility for better troughing and outstanding resistance to impact of the belt, and provides greater crosswise strength in the belts, as well as an improved base for holding mechanical fasteners.

Fabric quality stays high, mile after mile



The fabric being frictioned here is Wellington Sears "Columbus" cotton sheeting. It is recognized and preferred by makers of high-grade tape, hospital sheeting, heavy-duty raincoats and other products, for its constantly uniform quality. The kind of dependability these manufacturers expect and get in "Columbus" sheeting runs through the whole range of cotton and synthetic fabrics engineered by Wellington Sears for the rubber industry.

Whether you need fabrics for conveyor belts, hose, transmission belts, gaskets, tires, footwear or any use—you're putting to work over a hundred years of experience when you call on Wellington Sears. And that means more practical know-how to help you solve your particular problem.

Use it—it's yours for the asking. For our informative booklet, "Modern Textiles for Industry," write Dept. H-8.

Photo Courtesy of Okonite Company

Wellington Sears

A Subsidiary of West Point Manufacturing Company

FIRST In Fabrics For Industry

For Mechanical Goods, Coated Materials, Tires, Footwear and Other Rubber Products

WEST POINT TEXTILES

Wellington Sears Co., 65 Worth St., New York 13, N. Y. • Atlanta • Boston • Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis

STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

Year	Natural	GR-S	SBR-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1947	688,354	405,496	3,362	62,824	31,495	6,618	1,198,149
1948	735,227	390,240	15,252	56,662	34,848	7,012	1,239,241
1949	660,792	288,882	21,717	54,046	35,215	11,072	1,071,724
1950	802,249	350,801	28,086	60,915	50,067	12,037	1,304,155
1951	733,048	694,583	9,946	76,475	58,907	15,333	1,588,292
1952	805,997	636,969	17,885	81,630	65,745	16,228	1,624,454
1953	647,615	668,386	12,342	79,801	80,495	20,198	1,508,837
1954	596,848	472,698	17,707	58,802	69,150	21,396	1,236,601
1955							
Jan.	49,941	57,607	1,436	3,220	6,983	2,215	121,402
Feb.	50,880	55,293	1,149	3,727	6,910	1,659	119,618
Mar.	61,250	63,940	1,229	5,256	7,132	2,409	141,216
Apr.	61,113	50,745	10,081	5,148	8,359	2,433	137,879
May	61,042	3,592	63,220	5,115	7,852	2,720	143,541
June	52,762	3,739	61,717	3,872	5,919	3,422	131,431
July	43,626	1,640	64,910	5,395	6,904	3,195	125,670
Aug.	59,840	....	68,898	4,203	8,511	2,792	144,244
Sept.	50,459	....	68,228	5,097	7,677	2,821	134,282
Oct.	45,720	....	73,103	5,501	8,118	2,958	135,400
Nov.	50,509	....	75,745	4,935	8,537	2,931	142,657
Dec.	48,032	....	74,813	4,710	8,455	3,068	139,078
Total	635,174	236,556	564,589	56,179	91,357	32,623	1,616,478
1956							
Jan.	58,803	....	76,028	6,896	8,207	3,125	153,059
Feb.	53,353	....	73,457	6,229	8,560	2,989	144,588
Mar.	52,749	....	77,812	5,686	7,822	3,663	147,732
Apr.	51,394	....	74,502	5,685	8,481	3,648	143,710
May*	.....	....	77,639	5,433	7,795	....	.....

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	SBR-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1947	562,661	446,316	2,273	68,838	37,703	4,536	1,122,327
1948	627,332	334,233	11,080	58,870	32,118	5,771	1,069,404
1949	574,522	299,420	21,717	52,664	31,753	8,827	988,903
1950	720,268	388,427	27,803	66,348	43,781	11,930	1,258,557
1951	454,015	617,200	9,244	70,500	48,887	13,066	1,212,912
1952	453,846	648,816	17,604	71,229	55,522	13,866	1,260,883
1953	553,473	611,748	12,433	77,826	65,900	16,929	1,338,309
1954	596,285	483,001	17,344	61,464	57,203	17,715	1,233,412
1955							
Jan.	56,911	54,728	1,643	4,478	5,676	1,931	125,367
Feb.	50,997	54,707	1,293	4,312	5,476	1,921	118,706
Mar.	58,472	62,548	1,189	4,839	6,423	2,174	135,645
Apr.	52,963	54,091	5,655	4,321	5,884	2,172	125,086
May	54,746	2,533	60,325	4,455	6,143	1,965	130,167
June	56,282	3,666	62,226	4,704	6,320	2,581	135,779
July	46,166	2,690	50,398	3,894	4,294	1,621	109,063
Aug.	48,359	....	59,746	4,307	6,450	2,219	121,268
Sept.	50,963	....	63,330	4,578	6,197	2,270	127,338
Oct.	54,995	....	66,744	4,739	6,626	2,280	135,374
Nov.	52,769	....	68,111	4,420	6,896	2,234	134,430
Dec.	48,377	....	63,149	4,219	6,491	2,167	124,403
Yr.-end adj.	+2,800	....	+3,225	+725	....	+500	+7,250
Total	634,800	234,963	507,034	53,991	72,876	26,035	1,529,699
1956							
Jan.	53,751	....	65,375	4,223	6,684	2,198	132,231
Feb.	50,285	....	62,366	4,155	6,430	2,289	125,525
Mar.	50,040	....	64,458	4,515	6,542	2,373	127,928
Apr.	47,446	....	62,179	4,228	6,125	2,150	122,128
May*	47,899	....	62,634	4,170	6,265	2,026	122,994

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

Like a claw, Dow chelating agents firmly grasp and hold metal ions in solution, preventing them from undergoing the usual chemical reactions. But why so many Versene products? Are they effective on all metallic ions? We hope this continued discussion provides the answers, and further clarifies what chelates will do—and won't do.

DOW

The Chemistry of Chelation: Part III

Specific agents for specific conditions · Caustic solutions Changing solutions · Industry responds

In all, Dow offers 15 commercially available chelation products. These are grouped in the Versene®, Versenol®, and iron specialty (Versene Fe-3 Specific®, Versene T®, Versene S) series. The Versene and Versenol series were discussed in Part II of this advertisement. When used in solution, the Versene products inactivate practically any polyvalent metallic ion they contact. They accomplish this by actually forming a new compound in which the metal ion becomes a member of a stable inner ring structure in the molecule, so that no reversion or breakdown can occur. However, no one chelating agent can complex all metal ions under all conditions. One of the major considerations determining which chelating agent to use is pH. To illustrate, let's look at iron-containing systems, among the most troublesome for chemical processors.

SPECIFIC AGENTS FOR SPECIFIC CONDITIONS

The first amino acid type chelate made commercially available was Versene, the tetrasodium salt of EDTA*. It is the most versatile member of the series for it ties up most polyvalent metal ions throughout the pH range—with this notable exception: It is excellent for complexing iron in the acid range only. For economy above pH 7, we must look to a later development, Versene Fe-3 Specific.

The most effective and efficient agent known for complexing iron in the mildly alkaline pH range, Versene Fe-3 Specific also chelates copper, nickel, and cobalt—but has no effect on calcium, magnesium or other common non-transition metal ions. Where calcium and magnesium along with iron cause difficulty in alkaline solutions, a blend of Versene and Versene Fe-3 Specific is the answer. This mixture, called Versene Fe-3, complexes all of these troublesome ions. Its Versene Fe-3 Specific content is sufficient so as to automatically take care of the quantity of iron normally encountered in hard water.

Versene Fe-3 is also considered an important adjunct to the polymerization of synthetic rubber. It controls the concentration of the iron ions catalyzing the reaction, thus insuring a more-uniform, higher-quality end product.

CAUSTIC SOLUTIONS

For chelating iron in caustic solution, another agent enters the picture—Versene T. This material ties up iron in a wide range of caustic solution concentrations. It also complexes calcium, magnesium, nickel, cobalt, and other metal ions—throughout the normal pH range as well as in caustic solutions. In the presence of a suitable reducing agent, Versene T functions effectively as a rust remover—and without the drawbacks of acid cleaners. Versene T thus finds widespread use in boiler and heat exchanger cleaning, textile processing, etc.

Another effective chelating agent that is selective for iron in the free caustic pH range is Versene S. Since it will not chelate alkaline earth ions, Versene S is especially suitable for use in silicate-lined textile processing kiers.

CHANGING SOLUTIONS

In special instances where a processing solution is strongly alkaline at first, then changes to neutral or to acidic, iron can be controlled with a mixture of Versene T and Versene Fe-3 Specific. In this combination, the Versene T component complexes the iron when the solution is caustic. As the pH drops, Versene Fe-3 Specific takes over.

INDUSTRY RESPONDS

Every day, Dow chelates are finding new and expanding usage —in textile manufacturing and rubber processing, in soaps, synthetic detergents, cosmetics, and pharmaceuticals. Their ability to control ionic concentrations, to eliminate product breakdown, to smooth out production and save money, has brought enthusiastic response from industry. That they are solving a multitude of processing problems is true. But chelates are no cure-all. To uncover their profitable uses, we will help in any way we can. Write us on your company letterhead for application data and technical assistance. Technical Service and Development, Department SC 913N, THE DOW CHEMICAL COMPANY, Midland, Michigan.

*Ethylenediaminetetraacetic acid

THE NEXT TOPIC IN THIS SERIES

PART IV *October* — Applications in specific industries (formulation of alkaline cleansers—stabilization of hydrogen peroxide and kier boiling in textile processing—uniform control of trace metal catalysts in polymerization of synthetic rubber—other industrial applications).

you can depend on DOW CHEMICALS DOW

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1943	36,395	1,033	6,644	3,223	47,295
1944	122,412	9,992	12,262	5,366	150,032
1945	170,571	18,378	9,703	4,802	203,454
1946	83,090	19,478	10,470	3,755	116,793
1947	40,606	13,184	5,237	3,339	62,366
1948	96,304	10,995	5,072	2,762	115,133
1949	77,743	12,224	4,654	3,433	98,054
1950	36,942	7,243	5,733	2,840	52,758
1951	105,271	12,481	8,379	3,821	129,952
1952	83,861	22,716	8,535	3,875	118,987
1953	135,153	24,866	11,480	4,346	175,845
1954	115,499	19,267	11,349	4,280	150,395
1955					
Jan.	114,976	17,079	11,598	4,121	147,774
Feb.	111,796	15,424	10,555	3,888	141,663
Mar.	113,594	15,096	11,037	3,860	143,587
Apr.	112,156	14,813	10,863	3,612	141,444
May	109,381	14,449	10,283	3,995	138,108
June	103,844	13,053	9,755	4,042	130,694
July	110,281	13,288	11,213	5,120	139,902
Aug.	108,211	12,395	11,326	5,118	137,050
Sept.	107,641	12,190	11,209	4,995	136,035
Oct.	105,746	12,146	11,820	5,041	134,753
Nov.	105,287	11,646	11,530	5,201	133,664
Dec.	108,339	10,180	12,220	5,580	136,319
Yr.-end adj.	+650	+320	.....	+450	+1,420
	108,989	10,500	12,220	6,030	137,739
1956					
Jan.	111,263	12,303	11,850	6,316	141,732
Feb.	114,389	13,027	11,888	6,602	145,906
Mar.	118,063	13,458	12,037	7,437	150,995
Apr.	121,054	14,071	12,042	8,243	155,370
May*	126,491	14,947	11,269	8,600	161,307

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1943	3,638	....	....	....	....	5,638
1944	2,443	....	....	....	....	2,443
1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955						
Jan.	9,684	5,861	1,067	812	7,740	17,424
Feb.	8,619	5,753	879	692	7,324	15,943
Mar.	7,820	6,940	909	658	8,507	16,327
Apr.	6,790	7,098	786	725	8,609	15,399
May	8,854	7,021	767	842	8,630	17,484
June	9,788	6,645	817	958	8,420	18,208
July	11,934	6,950	850	1,155	8,955	20,889
Aug.	11,962	6,201	885	1,076	8,162	20,124
Sept.	12,595	6,448	975	1,296	8,719	21,314
Oct.	12,156	5,798	1,075	1,196	8,069	20,225
Nov.	12,616	6,307	1,089	1,174	8,570	21,186
Dec.	12,628	6,480	1,236	1,282	8,998	21,626
Yr.-end adj.	+575	+500	....	+525	+1,025	+1,600
	13,203	6,980	1,236	1,807	10,023	23,226
1956						
Jan.	16,059	6,522	1,093	1,906	9,521	25,580
Feb.	16,735	7,011	1,162	1,943	10,116	26,851
Mar.	18,309	6,867	1,097	2,340	10,304	28,613
Apr.	21,384	7,415	1,163	2,272	10,850	32,234
May†	20,895	7,311	1,095	1,584	9,990	30,885

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes SBR-Types.
† Preliminary.

U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1943	1,890	194	1,512	....	1,706	3,596
1944	3,090	6,580	4,683	....	11,263	14,353
1945	4,768	15,176	7,077	....	22,253	27,021
1946	8,012	24,810	13,595	....	38,405	46,417
1947	17,675	22,474	6,089	....	28,563	46,238
1948	32,630	21,494	5,022	....	26,516	59,146
1949	29,974	21,357	3,651	....	25,008	54,982
1950	54,401	31,339	5,725	....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955						
Jan.	7,853	6,199	617	708	7,524	15,377
Feb.	6,110	5,634	797	525	6,956	13,066
Mar.	7,611	7,078	854	738	8,670	16,281
Apr.	8,550	5,680	975	972	7,627	16,177
May	8,849	5,337	880	815	7,032	15,881
June	7,736	4,777	905	1,450	7,132	14,868
July	8,702	4,800	641	951	6,392	15,094
Aug.	8,885	4,519	881	1,010	6,410	15,295
Sept.	8,109	5,769	994	1,091	7,854	15,963
Oct.	6,900	6,231	922	883	8,036	14,936
Nov.	7,085	6,933	1,004	781	8,718	15,803
Dec.	6,364	6,407	962	874	8,243	14,607
Total	92,754	69,364	10,432	10,798	90,594	183,348
1956						
Jan.	10,328	6,885	848	919	8,652	18,980
Feb.	7,671	6,943	930	827	8,700	16,371
Mar.	7,800	5,911	782	1,158	7,851	15,651
Apr.	6,995	6,097	969	866	7,922	14,917
May†	....	.....	939	614	.....	.....

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes SBR-Types.
† Preliminary.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1943	304,058	291,082	15,678	46,201
1944	260,631	251,083	11,800	43,832
1945	243,309	241,036	13,413	28,155
1946	295,612	275,410	14,461	33,666
1947	291,395	288,395	14,556	35,943
1948	266,861	261,113	11,428	32,630
1949	224,029	222,679	10,367	28,263
1950	314,008	303,733	11,740	35,708
1951	366,700	346,121	14,722	45,082
1952	274,981	280,002	11,180	30,664
1953	298,336	285,050	11,397	32,319
1954	258,101	249,049	10,232	30,746
1955				
Jan.	25,336	25,322	1,041	29,656
Feb.	25,444	24,333	1,085	30,125
Mar.	29,574	28,674	1,088	30,311
Apr.	26,817	26,609	1,088	30,068
May	27,911	27,652	1,056	29,528
June	30,451	29,157	1,128	29,725
July	24,114	22,563	1,176	29,939
Aug.	25,223	25,790	1,144	27,956
Sept.	26,512	26,340	1,018	27,110
Oct.	28,038	26,597	1,381	27,565
Nov.	29,124	27,229	1,313	28,473
Dec.	28,105	24,515	1,470	31,058
Year.-end adj.	.....	—2,000	.....	+440
Total	326,649	312,781	13,988	31,498
1956				
Jan.	26,205	25,827	1,382	31,640
Feb.	27,108	25,571	1,115	31,875
Mar.	28,468	26,176	1,163	33,326
Apr.	26,933	23,999	1,179	34,360
May*	25,391	23,383	.....	34,706

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

FOR HIGH SPEED *Extrusion Compounds*

BURGESS "ICEBERG" and BURGESS "PIGMENT NO. 20"

—Aluminum Silicate Pigments specifically designed for use in natural rubber and GR-S high speed wire compounds:

TYPICAL WIRE INSULATION FORMULATION

GR-S	100	**Burgess Iceberg Pigment**	15
Process Oil	5	**Burgess Pigment #20**	60
Millex	40	Sulfur	2
Sun Check Wax	4	Litharge	5
Stearic Acid	1	M.B.T.S.	1
Age Rite Resin D	1	Zimate	1
Age Rite White	0.5		
Zinc Oxide	15		
Whiting (Water Ground)	50		300.5

BURGESS ICEBERG* An anhydrous aluminum silicate pigment for use as a filler in natural or synthetic rubber compounds. It is an exceptionally good white filler and provides outstanding processing and electrical properties. It offers excellent resistance to alkalis and acids, provides high specific resistance and low moisture absorption properties. In natural rubber compounds a small amount of "Iceberg" (approximately 20% filler content) will help prevent stickiness on the mill and also prevent die-plating of extrusion compounds.

BURGESS PIGMENT NO. 20—a hydrous aluminum silicate pigment in both natural and synthetic rubber compounds which provides level cures because of controlled pH. This Burgess water-washed kaolin type pigment is uniform in particle size, has excellent color and maximum freedom from impurities. It reduces tendency towards scorching and the forming of agglomerates and permits smoother extrusions at higher speeds.

Write for technical data, working samples and prices on these two Burgess products

For those desiring an even finer product—we recommend BURGESS "ICECAP K" in place of ICEBERG. "ICECAP K" will give superior results.

Burgess Pigment COMPANY

Mines and Plants: Sandersville, Georgia

EXECUTIVE SALES OFFICES: P. O. BOX 145, SANDERSVILLE, GA.
West Coast: L. H. Butcher Co., San Francisco & Los Angeles, Cal.
Warehouses: Jersey City & Trenton, N. J.; Saylesville, R. I.

- **HYDROUS AND ANHYDROUS ALUMINUM SILICATE PIGMENTS**
- **KAOLIN CLAYS**

U.S.A. Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1952	29,451	32,985	1,014	63,449	65,073	12,036
1953	37,957	36,072	878	74,907	74,425	11,874
1954	25,090	35,442	948	61,480	58,397	
1955						
Jan.	413	3,629	74	4,116	3,089	8,252
Feb.	352	2,430	80	2,862	2,850	8,243
Mar.	491	2,732	105	3,328	3,234	8,217
Apr.	530	2,635	85	3,250	2,836	7,963
May	531	2,617	85	3,233	3,005	7,735
June	477	3,003	85	3,565	3,136	7,326
July	475	2,915	60	3,450	2,768	6,664
Aug.	394	3,274	65	3,733	2,923	5,917
Sept.	360	2,814	86	3,261	3,169	5,966
Oct.	319	2,595	89	3,004	3,119	6,286
Nov.	355	2,427	93	2,875	3,052	6,734
Dec.	305	2,289	92	2,686	2,719	6,833
Total	5,002	33,360	999	39,363	35,900	
1956						
Jan.	274	3,263	72	3,608	2,918	6,294
Feb.	273	2,548	100	2,921	2,969	6,547
Mar.	282	2,587	93	2,962	3,347	6,848
Apr.	265	2,444	88	2,797	3,094	7,312
May	280	2,515	83	2,878	3,093	7,657

Source: The Rubber Manufacturers Association, Inc.

Carbon Black Statistics — First Five Months, 1956

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, semi-abrasion furnace black.

(Thousands of Pounds)

	Jan.	Feb.	Mar.	Apr.	May
Production					
Furnace types					
Thermal	11,874	11,478	12,127	10,665	11,712
SRF	34,047	30,367	31,692	28,711	31,622
HMF	10,401	8,681	7,984	8,764	8,972
FEF	20,776	19,518	21,359	19,948	18,339
HAF	36,802	36,807	38,058	33,832	38,830
SAF, ISAF	13,918	13,555	16,228	20,145	17,149
Total furnace	127,818	120,406	127,448	122,065	126,624
Contact types	32,222	28,717	31,552	30,460	30,613
Totals	160,040	149,123	159,000	152,525	157,237
Shipments					
Furnace types					
Thermal	11,846	11,361	11,204	10,242	10,376
SRF	32,165	26,973	27,492	25,239	26,646
HMF	9,453	8,420	9,051	9,184	8,068
FEF	19,381	16,379	17,559	18,369	17,413
HAF	36,934	35,142	36,374	31,287	37,319
SAF, ISAF	14,500	14,762	15,637	15,015	14,517
Total furnace	124,279	113,037	117,317	109,336	114,339
Contact types	33,256	31,548	30,377	31,032	31,582
Totals	157,535	144,585	147,694	140,368	145,921
Producers' Stocks, End of Period					
Furnace types					
Thermal	6,013	6,130	7,053	7,476	8,812
SRF	21,021	24,415	28,615	32,087	37,063
HMF	21,304	21,565	20,498	20,078	20,982
FEF	24,957	28,096	31,896	33,475	34,401
HAF	36,323	37,988	39,672	42,217	43,728
SAF, ISAF	26,669	25,462	26,053	31,133	33,815
Total furnace	136,287	143,656	153,787	166,516	178,801
Contact types	95,294	92,463	93,638	93,066	92,097
Totals	231,581	236,119	247,425	259,582	270,898
Exports					
Furnace types	21,806	24,725	24,105	17,295	.....
Contact types	11,886	15,097	12,607	14,957	.....
Totals	33,692	39,822	36,712	32,252	.....

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1952	9,467	126	9,813	2,695	22,101
1953	7,692	237	11,494	3,245	22,668
1954	11,069	2,831	12,062	4,155	30,117
1955					
Jan.	1,381	716	1,046	194	3,337
Feb.	1,331	370	1,049	259	3,009
Mar.	2,162	672	1,287	236	4,357
Apr.	1,807	1,562	1,636	506	5,511
May	3,500	376	1,430	357	5,663
June	6,030	726	1,541	389	8,686
July	5,212	870	1,275	472	7,829
Aug.	7,727	837	1,454	386	9,567
Sept.	8,598	526	1,946	602	11,672
Oct.	7,888	1,041	1,748	444	11,121
Nov.	7,786	894	1,824	306	10,810
Dec.	7,282	1,305	1,862	442	10,891
Total	60,704	9,895	18,098	4,593	93,290
1956					
Jan.	7,550	815	1,757	506	10,628
Feb.	9,018	1,624	1,521	449	12,612
Mar.	10,804	764	1,500	522	13,590
Apr.	10,271	374	1,917	587	13,149

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954	75,931	44,173	7,251	4,507	55,931	131,862
1955						
Jan.	7,355	4,537	661	509	5,707	13,062
Feb.	7,066	4,881	689	505	6,075	13,141
Mar.	8,415	5,861	828	512	7,201	15,616
Apr.	7,732	5,209	748	606	6,563	14,295
May	6,643	4,278	768	496	5,542	12,185
June	6,589	4,885	722	591	6,198	12,787
July	5,469	3,830	535	430	4,795	10,264
Aug.	6,784	4,514	770	547	5,831	12,615
Sept.	7,452	5,505	730	595	6,830	14,282
Oct.	7,209	5,704	739	614	7,057	14,266
Nov.	6,620	5,954	829	603	7,386	14,006
Dec.	6,344	5,599	717	587	6,903	13,247
Yr.-end adj.	+2,800	+2,775	....	+1,900	+4,675	+7,475
Total	86,478	63,982	8,736	8,495	81,213	167,691
1956						
Jan.	6,776	5,858	772	670	7,300	14,076
Feb.	6,399	5,913	787	730	7,430	13,829
Mar.	6,438	5,888	729	781	7,398	13,836
Apr.	5,693	4,923	741	692	6,356	12,049
May†	4,961	4,577	753	499	5,829	10,790

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
† Preliminary. * Includes SBR-Types.

U.S.A. Rubber Industry Sales and Inventories

(Million of Dollars)

	Value of Sales*: 1953	1954	1955	1956	Manufacturers' Inventories*: 1953	1954	1955	1956
Jan.	424	348	424	415	866	844	790	935
Feb.	435	351	440	445	868	857	782	970
Mar.	473	388	466	451	880	849	805	979
Apr.	444	375	445	451	874	812	784	979
May	422	357	465	...	888	810	810	...
June	436	377	465	...	914	829	850	...
July	448	374	471	...	925	784	853	...
Aug.	409	337	456	...	897	761	863	...
Sept.	416	334	456	...	908	804	874	...
Oct.	395	332	447	...	881	838	902	...
Nov.	346	388	482	...	867	819	935	...
Dec.	369	407	465	...	868	929	934	...
Total	5,017	4,368	5,493	....	Av. 853	831	845	...

Source: Office of Business Economics, U. S. Department of Commerce.
* Adjusted for seasonal variation.

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Address All Replies to New York Office at 386 Fourth Avenue, New York 16, N. Y.

SITUATIONS OPEN

TECHNICAL SALESMAN

Familiar with rubber manufacturing technology including natural, synthetic and particularly urethane type rubber. Headquarters and majority of work in Akron, Ohio with periodic traveling required thruout the U.S. and Canada. Salary + expenses and automobile.

Submit resume to Personnel Dept:

NATIONAL ANILINE DIVISION
ALLIED CHEMICAL & DYE CORP.
40 Rector St, NY, NY

TECHNICAL SALES REPRESENTATIVE

Must have sales experience and good technical background in adhesives for rubber bonding. To travel in northeastern United States. Good opportunity with progressive, expanding company. Address Box No. 1943, care of RUBBER WORLD.

RUBBER CHEMIST WANTED FOR DEVELOPMENT LABORATORY in northern New Jersey. Degree in chemistry or chemical engineering. At least three years' experience in rubber and polymer compounding and development. Medium-sized company in expanding operation. Write giving full résumé and salary expected. Address Box No. 1944, care of RUBBER WORLD.

VINYL CHEMIST

Experienced in compounding and coating plastisols and organosols. Excellent opportunity in New England area. Give complete résumé and salary expected. All replies will be strictly confidential. Address Box No. 1945, care of RUBBER WORLD.

IN SOUTH CAROLINA

Rubber Chemist to head new development group, director level. Ph.D. preferred, but not required. A real opportunity in an expanding company. CONTINENTAL TAPES, Cayce, S. C.

COMPOUNDER

Experienced in wire insulation splicing or pressure-sensitive tapes or calendered printing gums, stamp gums, etc., desired. Essex County, N. J. Address Box No. 1946, care of RUBBER WORLD.

CAMELBACK CONSULTANT
Part Time

Small Quebec rubber company, now contemplating camelback production, needs an expert to help plan and advise on all phases of producing top-quality camelback. Occasional week-ends and evenings, or other convenient part-time consultations only would be required. Address Box No. 1947, care of RUBBER WORLD.

TILING ENGINEER
WANTED
Vinyl Asbestos or Vinyl

Excellent opportunity for man having at least two or three years' experience. Liberal Pension & Hospitalization program. Location Midwest. Address Box No. 1948, care of RUBBER WORLD.

FLOOR TILE CHEMIST
WANTED

Experienced manufacturer vinyl tile. Insurance, Hospitalization, and retirement. Replies treated confidentially. Address Box No. 1949, care of RUBBER WORLD.

SALES HELP WANTED

Sales Representatives who can produce business for efficient plant producing top-quality molded goods, extrusions, PVC linings, coatings and shapes. Several excellent territories open on commission basis. Address Box No. 1958, care of RUBBER WORLD.

SITUATIONS OPEN (Continued)

WANTED: YOUNG CHEMIST FOR SMALL CONNECTICUT company manufacturing sponge rubber and molded rubber products. Address Box No. 1950, care of RUBBER WORLD.

CHIEF CHEMIST: LARGE LATEX-FOAM PILLOW AND CUSHioning manufacturer seeks experienced latex foam chemist to assume complete charge compounding activities, research, and development. Salary open. Excellent future. Replies confidential. Submit full résumé and salary requirements. Address Box No. 1957, care of RUBBER WORLD.

EXECUTIVE OPPORTUNITY. Management chance for young man in sales and manufacturing field with established New England firm in Boston area. Knowledge of Rubber Chemistry and manufacturing essential. College Graduate. Personality and drive important in growing company. Send résumé in confidence to Box No. 1959, care of RUBBER WORLD, for prompt interview.

SITUATIONS WANTED

TWO RUBBER CHEMICAL SALESMEN, WITH EXCELLENT technical service background seek new association with rubber chemicals distributor, or rubber chemicals manufacturer. Wide contacts from Akron to Atlantic Coast. Business builders with industry-wide following. Address Box No. 1951, care of RUBBER WORLD.

EXPERIENCED RUBBER CHEMIST AND DEVELOPMENT engineer desires change with opportunity for advancement. Address Box No. 1952, care of RUBBER WORLD.

CHEMIST, B. S., OVER 15 YEARS' EXPERIENCE IN COATings, laminations, pressure adhesives, emulsions, molded, extruded products, tapes, quarterlining; is reliable and very thorough man for laboratory compounding and to follow-up compounds in production. Salary reasonable to both parties. Address Box No. 1953, care of RUBBER WORLD.

LATEX CHEMIST, 10 YEARS' EXPERIENCE IN DIPPED goods, textile coating, and latex foam. Experienced in emulsion technique, dispersions, compounding, and in coagulants. Interested in position involving either technical service or plant research and development work. Willing to relocate. Address Box No. 1954, care of RUBBER WORLD.

The Classified Ad Columns of RUBBER WORLD bring prompt results at low cost.

MACHINERY & SUPPLIES FOR SALE

FOR SALE: 2—FARREL 40" REBUILT MILLS; 1—TAYLOR-Stiles Giant Rubber Cutter; 1—6" x 12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size O, m.d.; 1—Farrel 12 x 24" Heavy-Duty Mill; also other sizes Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. WANTED: Your Surplus Rubber Machinery. CONSOLIDATED PRODUCTS CO., INC., 64 Bloomfield St., Hoboken, N. J. HOboken 3-4425; N. Y. Phone: BArclay 7-0600.

WE OFFER FOR SALE
2100 FLAT ALUMINUM DIPPING MOLDS FOR LATEX BATHING CAPS.
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ENGINEERING FACILITIES FOR SPECIAL EQUIPMENT
Call or write.

World Production ot Natural Rubber

(1,000 Long Tons)

Year	Malaya		Indonesia		All Other	Total
	Estate	Native	Estate	Native		
1947	360.5	285.8	12.8	265.2	335.7	1,260.0
1948	403.6	294.6	101.7	330.6	394.5	1,525.0
1949	400.8	270.7	169.1	263.9	385.5	1,490.0
1950	376.7	317.4	175.1	521.4	469.4	1,860.0
1951	328.8	276.5	222.5	591.9	465.3	1,885.0
1952	341.7	242.5	293.2	456.0	456.6	1,790.0
1953	341.8	232.6	301.8	390.4	458.4	1,725.0
1954	343.5	240.8	280.5	464.3	473.4	1,802.5
1955						
Jan.	29.3	27.9	23.6	17.1	42.1	140.0
Feb.	28.5	20.4	22.3	48.1	38.2	157.5
Mar	27.5	26.7	23.0	23.8	39.0	140.0
Apr.	24.2	20.5	20.7	27.4	42.2	135.0
May	27.4	22.4	18.0	30.1	37.1	135.0
June	27.6	22.9	21.3	52.7	40.5	165.0
July	30.3	25.7	21.2	32.5	55.3	165.0
Aug.	30.7	23.6	20.0	43.2	37.5	155.0
Sept.	31.3	24.9	20.3	45.2	45.8	167.5
Oct.	30.8	24.0	22.0	44.8	48.4	170.0
Nov.	30.3	21.9	23.4	37.3	44.6	157.5
Dec.	35.0	27.3	24.5	70.2	50.5	207.5
Total	352.9	286.2	261.3	472.4	521.2	1,895.0
1956						
Jan.	32.6	26.5	23.5	17.4	42.5	142.5
Feb.	27.6	24.3	23.0	20.9	36.7	132.5
Mar.	28.5	22.5	21.5	16.4	41.1	130.0
Apr.	26.7	21.7	20.0	46.1	40.4	155.0

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.

World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	U.S.S.R.* and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1947	562.7	57.2	153.6	336.5	547.3	1,100.0
1948	627.3	121.0	193.7	480.5	795.2	1,422.5
1949	574.5	132.5	184.3	546.2	863.0	1,437.5
1950	720.3	152.5	219.7	612.5	984.7	1,705.0
1951	454.0	136.3	234.2	675.5	1,046.0	1,500.0
1952	453.8	146.8	197.3	652.1	996.2	1,450.0
1953	553.5	101.9	206.6	753.0	1,061.5	1,615.0
1954						
Jan.	47.0	7.8	20.3	67.4	95.5	142.5
Feb.	46.9	....	17.5	70.6	88.1	135.0
Mar.	53.7	2.7	19.1	72.0	93.8	147.5
Apr.	51.4	15.5	19.7	68.4	103.6	155.0
May	51.4	1.1	18.8	66.2	86.1	137.5
June	54.2	3.6	18.0	64.1	85.7	140.0
July	37.9	0.8	17.7	68.6	87.1	125.0
Aug.	38.1	8.9	14.2	63.8	86.9	125.0
Sept.	52.4	11.5	19.3	71.8	102.6	155.0
Oct.	56.0	3.5	23.1	74.9	101.5	157.5
Nov.	53.3	2.3	19.2	75.2	96.7	150.0
Dec.	55.2	5.0	19.6	72.7	97.3	152.5
Total	597.5	62.7	226.5	835.7	1,124.9	1,725.0
1955						
Jan.	56.9	7.8	23.5	71.8	103.1	160.0
Feb.	51.0	....	20.1	....	89.0	140.0
Mar.	58.5	7.3	21.4	72.8	101.5	160.0
Apr.	53.0	....	23.3	....	104.5	157.5
May	54.7	....	20.5	....	97.8	152.5
June	56.3	2.8	18.3	80.1	101.2	157.5
July	46.2	1.8	18.3	73.7	93.8	140.0
Aug.	48.4	0.1	16.0	65.5	81.6	130.0
Sept.	51.0	2.1	19.8	72.1	94.0	145.0
Oct.	55.0	10.4	22.9	76.7	110.0	165.0
Nov.	52.8	17.1	20.0	77.6	114.7	167.5
Dec.	51.2	5.2	22.2	83.9	111.3	162.5
Total	634.8	56.2	246.3	900.2	1,202.7	1,837.5
1956						
Jan.	53.4	14.4	21.7	73.0	109.1	162.5
Feb.	50.1	19.1	17.9	72.9	109.9	160.0
Mar.	49.6	11.7	16.0	73.7	100.4	150.0
Apr.	47.0	14.6	18.4	72.5	105.5	152.5

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.
* Estimated.

World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany	Total
1953	848.4	80.9	6.3	935.6
1954	622.9	86.6	6.9	716.4
1955				
Jan.	69.9	8.1	0.9	78.9
Feb.	67.7	7.6	0.9	76.2
Mar.	78.5	8.7	0.8	88.0
Apr.	75.7	7.6	0.8	84.1
May	82.0	8.9	0.9	91.7
June	78.2	8.6	0.9	87.7
July	81.9	8.2	0.9	91.0
Aug.	84.0	8.1	1.0	93.1
Sept.	83.5	9.3	0.9	93.7
Oct.	89.1	9.9	1.0	100.0
Nov.	91.3	9.2	1.0	101.5
Dec.	90.3	9.7	1.0	101.0
Total	970.5	103.9	10.9	1,085.3
1956				
Jan.	93.5	9.7	1.0	104.3
Feb.	90.5	8.2		
Mar.	94.4	10.3	1.1	105.8
Apr.	91.6	10.3	...	....

Source: Secretariat of the International Rubber Study Group; and BDSA, United States Department of Commerce.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdom	Total† Continent of Europe	World† Grand Total
1953	784.8	35.9	4.9	39.3	872.5
1954	636.7	30.1	8.7	50.8	740.0
1955					
Jan.	68.4	2.6	1.2	5.8	80.0
Feb.	67.6	3.1	1.1	5.5	77.5
Mar.	77.1	3.4	1.2	6.0	90.0
Apr.	72.1	3.0	1.5	5.8	85.0
May	75.7	3.3	1.4	6.0	87.5
June	80.2	3.8	1.5	6.5	92.5
July	63.3	2.7	1.4	6.3	75.0
Aug.	73.3	2.7	1.5	6.3	87.5
Sept.	76.7	3.7	1.9	7.0	92.5
Oct.	80.4	3.6	2.6	7.5	97.5
Nov.	81.7	4.4	2.4	8.0	97.5
Dec.	80.5	4.0	2.7	7.8	95.0
Total	894.9	40.2	20.5	78.3	1,057.5
1956					
Jan.	78.5	4.0	3.1	9.3	97.5
Feb.	75.2	4.1	3.1	9.0	95.0
Mar.	78.3	4.1	3.1	8.5	97.5
Apr.	73.7	4.4	3.6	...	92.5

Source: Secretariat of the International Rubber Study Group; BDSA, United States Department of Commerce.
* Includes latices.
† Figures estimated or partly estimated.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1954	$90.76	40.7	$2.23
1955			
Jan.	93.02	40.8	2.28
Feb.	93.07	41.0	2.27
Mar.	94.12	41.1	2.29
Apr.	99.53	42.9	2.32
May	95.22	41.4	2.30
June	96.51	41.6	2.32
July	97.53	41.5	2.35
Aug.	99.96	42.0	2.38
Sept.	100.08	41.7	2.40
Oct.	98.83	41.7	2.37
Nov.	100.14	41.9	2.39
Dec.	100.98	41.9	2.41
1956			
Jan.	101.88	42.1	2.42
Feb.	101.57	41.8	2.43
Mar.	102.51	41.5	2.47

Source: BLS, United States Department of Labor.

MACHINERY AND SUPPLIES FOR SALE (Continued)

STOKES & KUX 2½"-DIA. SINGLE-PUNCH PREFORM MAchines. Farrel 15" x 36" 2-roll Rubber Mill and sizes up to 84". New and used Lab. 6" x 13", 6" x 16", and 8" x 16" Mills and Calenders. Day Imperial 75- & 150-gal. Jack Mixers. Baker-Perkins Jacketed Mixers 100 & 50 gals. Farrel 200-ton Hydr. Press 20" x 80" platens. Brunswick 225-ton, 21" x 21" platens. W.S. 150-ton Semi-Autom. Molding Press. Stokes 15-ton Fully-Autom. Molding Press. 150-ton 24" x 24" platens. 80-ton 20" x 20" platens. Large stock hydraulic presses 12" x 12" to 48" x 48" platens. Hydraulic Pumps and Accumulators. Hartig 3¼" Extruder, also 1½" to 4½". Rotary Cutters. Stokes Molding Presses. Single-Punch & Rotary Preform Machines. Banbury Mixers, Crushers, Churns, Bale Cutters, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY. STEIN EQUIPMENT CO., 107—8th Street, Brooklyn 15, N. Y. STerling 8-1944.

FOR SALE: 4—ADAMSON 20" x 20" PRESSES, 15" RAM; 1—Cameron 50" slitter, model 26-3A; 1—National Erie 3¼" tuber; 1—National Erie 8" tuber; also mills, calenders, vulcanizers, mixers, etc. CHEMICAL & PROCESS MACHINERY CORP., 52 Ninth Street, Brooklyn 15, N. Y.

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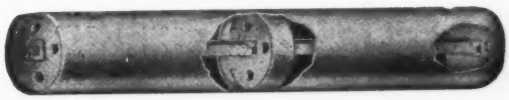

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U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
Passenger Car						
1955						
Jan.	3,481	4,139	79	7,699	7,797	12,363
Feb.	3,540	3,551	83	7,174	7,549	12,643
Mar.	4,326	4,255	104	8,685	8,810	12,874
Apr.	3,967	4,677	88	8,733	8,000	12,197
May	3,871	4,705	87	8,663	8,742	12,235
June	3,482	5,399	97	8,979	9,383	12,698
July	3,461	4,802	76	8,339	7,893	12,199
Aug.	2,984	5,058	60	8,103	7,585	11,636
Sept.	2,749	4,366	74	7,189	7,882	12,407
Oct.	3,172	3,556	74	6,802	8,160	13,806
Nov.	3,900	2,902	63	6,865	8,198	15,142
Dec.	3,641	2,746	81	6,467	7,223	15,963
Total	42,574	50,156	966	93,698	97,232	
1956						
Jan.	2,958	4,040	66	7,064	7,661	16,546
Feb.	2,919	3,387	90	6,396	7,571	17,701
Mar.	3,027	4,372	65	7,464	7,812	18,096
Apr.	2,787	4,994	67	7,847	7,530	17,649
May	2,349	5,203	65	7,617	7,628	17,714
Truck and Bus						
1955						
Jan.	303	827	81	1,211	1,243	2,586
Feb.	294	730	74	1,098	1,196	2,678
Mar.	454	672	96	1,222	1,273	2,734
Apr.	489	639	76	1,204	1,153	2,693
May	481	655	65	1,202	1,208	2,701
June	449	730	76	1,255	1,320	2,763
July	429	909	51	1,389	1,134	2,485
Aug.	378	922	59	1,359	1,132	2,272
Sept.	393	804	66	1,264	1,243	2,268
Oct.	324	904	88	1,315	1,395	2,357
Nov.	403	690	87	1,180	1,405	2,584
Dec.	404	552	91	1,047	1,255	2,815
Total	4,801	9,034	910	14,746	14,957	
1956						
Jan.	444	629	65	1,139	1,318	2,971
Feb.	424	565	88	1,077	1,326	3,232
Mar.	439	662	62	1,163	1,382	3,465
Apr.	430	767	74	1,271	1,303	3,483
May	421	777	65	1,264	1,358	3,582
Total Automotive						
1955						
Jan.	3,785	4,967	159	8,911	9,040	14,949
Feb.	3,833	4,281	157	8,272	8,745	15,321
Mar.	4,780	4,926	201	9,907	10,083	15,609
Apr.	4,457	5,315	165	9,937	9,153	14,890
May	4,352	5,361	152	9,865	9,949	14,936
June	3,931	6,129	174	10,234	10,703	15,460
July	3,890	5,711	128	9,729	9,027	14,684
Aug.	3,362	5,980	119	9,462	8,717	13,908
Sept.	3,142	5,171	140	8,453	9,125	14,675
Oct.	3,495	4,460	161	8,117	9,555	16,163
Nov.	4,303	3,592	150	8,045	9,603	17,727
Dec.	4,045	3,298	172	7,515	8,478	
Total	47,375	59,191	1,878	108,447	112,178	
1956						
Jan.	3,402	4,669	131	8,203	8,979	19,517
Feb.	3,343	3,953	178	7,473	8,897	20,934
Mar.	3,466	5,034	127	8,627	9,193	21,562
Apr.	3,217	5,761	141	9,119	8,834	21,132
May	2,770	5,980	130	8,880	8,987	21,296

Source: The Rubber Manufacturers Association, Inc.

U.S.A. 1955 Exports and Imports

	Exports			Imports		
Group	Value $	% of Total	% Increase Over 1954	Value $	% of Total	% Increase Over 1954
Rubber	75,511,006	35.6	130.6	451,232,392	97.67	63.2
Transportation products	85,719,163	40.4	14.1	4,608,660	1.00	63.2
Mech. goods	22,789,978	10.7	15.4	975,583	0.21	10.6
Footwear	810,946	0.4	4.5	859,600	0.19	69.7
Drug sundries	3,653,664	1.7	4.1	510,580	0.11	40.8
Misc.	23,752,870	11.2	18.3	3,779,778	0.82	33.3
Total	212,237,627	100.0	39.7	461,966,593	100.00	62.8

Source: Bureau of the Census, United States Department of Commerce.

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumers Price Index
		All Rubber Products			
1939	121	$27.84	39.9	$0.75	....
1953	221	77.78	40.3	1.93	114.4
1954	195	78.21	39.7	1.97	114.8
1955					
Jan.	210.5	84.25	41.3	2.04	114.3
Feb.	210.4	84.25	41.3	2.04	114.3
Mar.	211.2	83.44	40.9	2.04	114.3
Apr.	211.6	86.11	41.8	2.06	114.2
May	214.4	86.94	41.8	2.08	114.2
June	220.0	88.83	42.3	2.10	114.4
July	216.9	86.52	41.2	2.10	114.7
Aug.	219.0	86.32	41.3	2.09	114.5
Sept.	223.1	86.74	41.5	2.09	114.9
Oct.	226.4	89.04	42.0	2.12	114.9
Nov.	231.2	92.01	42.4	2.17	115.0
Dec.	233.9	89.21	41.3	2.16	114.7
1956					
Jan.	232.5	87.91	40.7	2.16	114.6
Feb.	227.6	85.81	40.1	2.14	114.6
Mar.	224.7	84.93	39.5	2.15	114.7
Apr.	224.6	....	....	....	114.9
		Tires and Tubes			
1939	54.2	$33.36	35.0	$0.96	
1953	93.0	88.31	39.6	2.23	
1954	79.7	87.85	38.7	2.27	
1955					
Jan.	87.6	97.41	41.1	2.37	
Feb.	86.5	96.46	40.7	2.37	
Mar.	87.4	95.27	40.2	2.37	
Apr.	88.4	101.28	42.2	2.40	
May	90.1	100.91	41.7	2.42	
June	91.0	105.60	43.1	2.45	
July	91.5	103.82	42.7	2.42	
Aug.	91.0	102.72	42.1	2.44	
Sept.	91.9	101.02	41.4	2.44	
Oct.	92.3	103.74	42.0	2.47	
Nov.	94.2	106.26	42.0	2.53	
Dec.	94.7	99.50	39.8	2.50	
1956					
Jan.	94.1	101.00	40.4	2.50	
Feb.	93.7	97.71	39.4	2.48	
Mar.	93.3	97.89	39.0	2.51	
		Rubber Footwear			
1939	14.8	$22.80	37.5	$0.61	
1953	23.7	65.60	40.0	1.64	
1954	20.7	67.43	39.9	1.69	
1955					
Jan.	22.1	68.97	40.1	1.72	
Feb.	21.5	69.72	40.3	1.73	
Mar.	21.4	69.72	40.3	1.73	
Apr.	21.2	70.99	40.8	1.74	
May	21.4	70.64	40.6	1.74	
June	21.6	71.34	41.0	1.74	
July	21.8	71.93	41.1	1.75	
Aug.	21.5	67.25	39.1	1.72	
Sept.	23.5	67.60	39.3	1.72	
Oct.	24.4	69.20	40.0	1.73	
Nov.	25.5	77.89	42.1	1.85	
Dec.	26.2	74.89	40.7	1.84	
1956					
Jan.	26.2	74.37	40.2	1.85	
Feb.	26.1	74.74	40.4	1.85	
Mar.	25.8	71.16	39.1	1.82	
		Other Rubber Products			
1939	51.9	$23.34	38.9	$0.61	
1953	104.1	70.93	41.0	1.73	
1954	94.3	71.91	40.4	1.78	
1955					
Jan.	100.8	76.08	41.8	1.82	
Feb.	101.4	76.86	42.0	1.83	
Mar.	102.4	76.13	41.6	1.83	
Apr.	101.1	76.13	41.6	1.83	
May	105.0	78.31	42.1	1.86	
June	106.4	77.93	41.9	1.86	
July	103.6	73.84	39.7	1.86	
Aug.	104.3	75.85	41.0	1.85	
Sept.	107.7	78.96	42.0	1.88	
Oct.	109.7	80.56	42.4	1.90	
Nov.	111.5	83.03	42.8	1.94	
Dec.	113.0	83.69	42.7	1.96	
1956					
Jan.	112.2	79.73	41.1	1.94	
Feb.	107.8	77.95	40.6	1.92	
Mar.	105.6	76.99	40.1	1.92	

Source: BLS, United States Department of Labor.

MACHINERY & SUPPLIES FOR SALE (Continued)

FOR SALE; MARCO PROCESS CONSISTING OF: KACR Reactor, Kom-bi-nators, Homogenizer, Roto-Feed Mixers, proportioners, etc., all stainless steel. Double-Arm Sigma Blade Jacketed Mixers: (2) Read 50 gal., 30 HP; (2) W & P 100 gal.; (2) Day 75-gal. st. st.; Kux model 25 rotary pellet presses, 21 and 25 punch. (7) Devine Vacuum Shelf Dryers #17, #23, #27. WE BUY SURPLUS EQUIPMENT. PERRY EQUIPMENT CORP., 1424 N. 6th St., Phila. 22, Pa.

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U.S.A. Production and Sales of Rubber Processing Chemicals

	1955				1954			
		Sales				Sales		
	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value* (per Lb.)	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value* (per Lb.)
Cyclic Rubber-Processing Chemicals								
Accelerators								
n-Butyraldehyde-aniline	481	452	276	$0.61	255	246	146	$0.59
Dithiocarbamic acid derivatives	466	433	512	1.18	203	193	368	1.91
Thiazole derivatives								
2,2′-Dithiobis[benzothiazole](2,2′-benzothiazyl sulfide)					14,725	10,617	5,017	$0.47
2-Mercaptobenzothiazole	18,542	5,362	2,041	.38	11,873	3,872	1,491	0.39
All others	36,779	31,673	16,652	.53	20,408	10,328	5,514	0.53
TOTAL	55,321	37,035	18,693	$0.50	47,006	24,817	12,022	$0.48
All other accelerators	9,531	8,836	6,407	.73	5,852	6,264	4,701	$0.75
TOTAL	65,799	46,756	25,888	$0.55	53,316	31,520	17,237	$0.55
Antioxidants								
Amino or hydroxy compounds	61,033	55,916	31,878	$0.57	24,625	23,089	14,103	$0.61
All others	14,549	11,249	6,400	.57	26,794	25,223	14,141	0.56
TOTAL	75,582	67,165	38,278	$0.57	51,419	48,312	28,244	$0.58
Peptizers, tackifiers, inhibitors, and blowing agents	7,050	6,718	6,288	.94	5,130	5,299	5,069	$0.96
TOTAL ALL CYCLIC RUBBER-PROCESSING CHEMICALS	148,431	120,639	70,454	$0.58	109,865	85,131	50,550	$0.59
Acyclic Rubber-Processing Chemicals								
Accelerators								
Dithiocarbamic acid derivatives†								
Dibutyldithiocarbamic acid, zinc salt	1,121	1,041	1,007	$0.97	654	746	691	$0.93
Diethyldithiocarbamic acid, zinc salt	2,159	1,503	1,305	.87	1,522	1,436	1,238	0.86
Dimethyldithiocarbamic acid potassium salt	202	75	39	.52		119	57	0.48
All others	4,873	2,407	1,806	.75	3,373	1,076	986	0.92
TOTAL	8,355	5,026	4,157	$1.03	5,549	3,377	2,972	$0.88
Tetramethylthiuram sulfides‡								
Tetramethylthiuram disulfide	5,249	3,576	3,561	$1.00	3,839	3,318	3,331	$1.01
Monosulfide	1,537	1,322	1,497	1.13	855	824	928	1.13
TOTAL	6,786	4,898	5,058	$1.03	4,694	4,142	4,259	$1.03
All others	756	348	397	1.14	3,324	2,933	1,570	$0.54
TOTAL	15,897	10,272	9,612	$0.94	13,567	10,452	8,801	$0.84
Peptizers, lubricating, conditioning, and blowing agents								
Dodecyl mercaptans	7,774	7,380	3,642	$0.49	3,843	3,638	1,934	$0.53
All others	5,018	4,733	2,086	.44	1,966	1,787	866	0.48
TOTAL	12,792	12,113	5,728	$0.47	5,809	5,425	2,800	$0.52
TOTAL ALL ACYCLIC RUBBER-PROCESSING CHEMICALS	28,689	22,385	15,340	$0.69	19,376	15,877	11,601	$0.73
TOTAL ALL RUBBER-PROCESSING CHEMICALS	177,120	143,024	85,794	$0.60	129,241	101,008	62,151	$0.62

* Calculated on round figures.
† Data on dithiocarbamates included in table are for material used exclusively in the processing of natural and synthetic rubbers.
‡ Includes data for small amounts of tetramethylthiuram sulfides for uses other than in processing of natural and synthetic rubbers.
Source: United States Tariff Commission.

Great Britain

(*Continued from page 754*)

sulting from simultaneous oxidative degradation and continued vulcanization. Aging curves for several polymer vulcanizates were used to demonstrate the different trends.

R. H. Norman dealt with the chief electrical properties of a wide range of rubber and PVC and showed that these properties depend largely on the degree of purity of the polymer used, the extent of oxidation, and the temperature of the test. Data on anti-static rubbers were given.

S. E. Bolam classified and compared the types of polymer dispersion or latex currently available in Great Britain, indicating the major features of each type of vulcanizable elastomer.

J. F. E. Ruffell compared the properties of neoprene and "Hypalon" and forecast a promising future for them because of their all-around excellence. He outlined the compounded systems required for best results.

Indonesia

Lifts Rubber Ban to China

The Republic of Indonesia has followed the lead of British Malaya and Singapore and lifted its rubber embargo on Red China. The decision, in effect, renders null and void the rubber ban in the strategic goods embargo voted against China by the United Nations General Assembly as a Korean war measure five years ago.

The Indonesian Foreign Ministry cited the action of the British colonies, the competition of synthetic rubber, and price fluctuations in natural rubber as reasons for the lifting of the embargo. Indonesia produces more than 300,000 tons of natural rubber a year.

The Foreign Ministry placed no limitations on the amount of rubber to be allowed the Red Chinese. Britain is theoretically permitting China quantities of rubber to cover purely non-military needs, but impartial observers have ridiculed the effectiveness of such a restriction in preventing the build-up of Chinese military strength.

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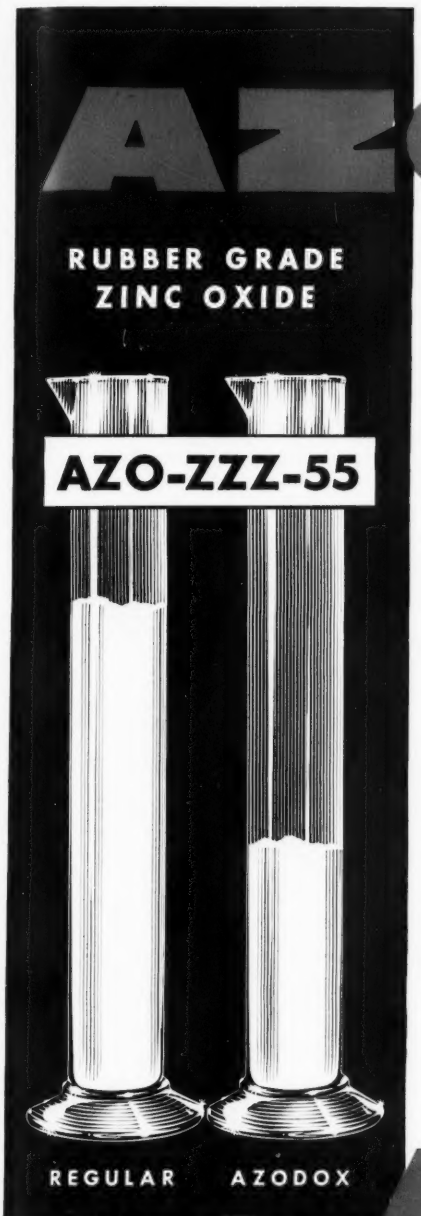

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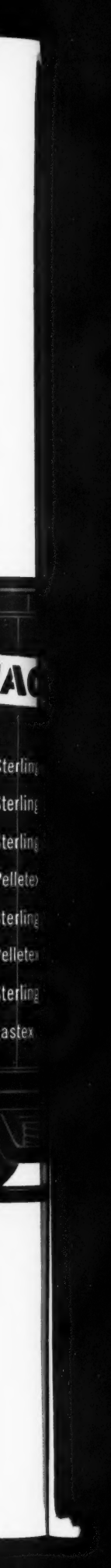
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